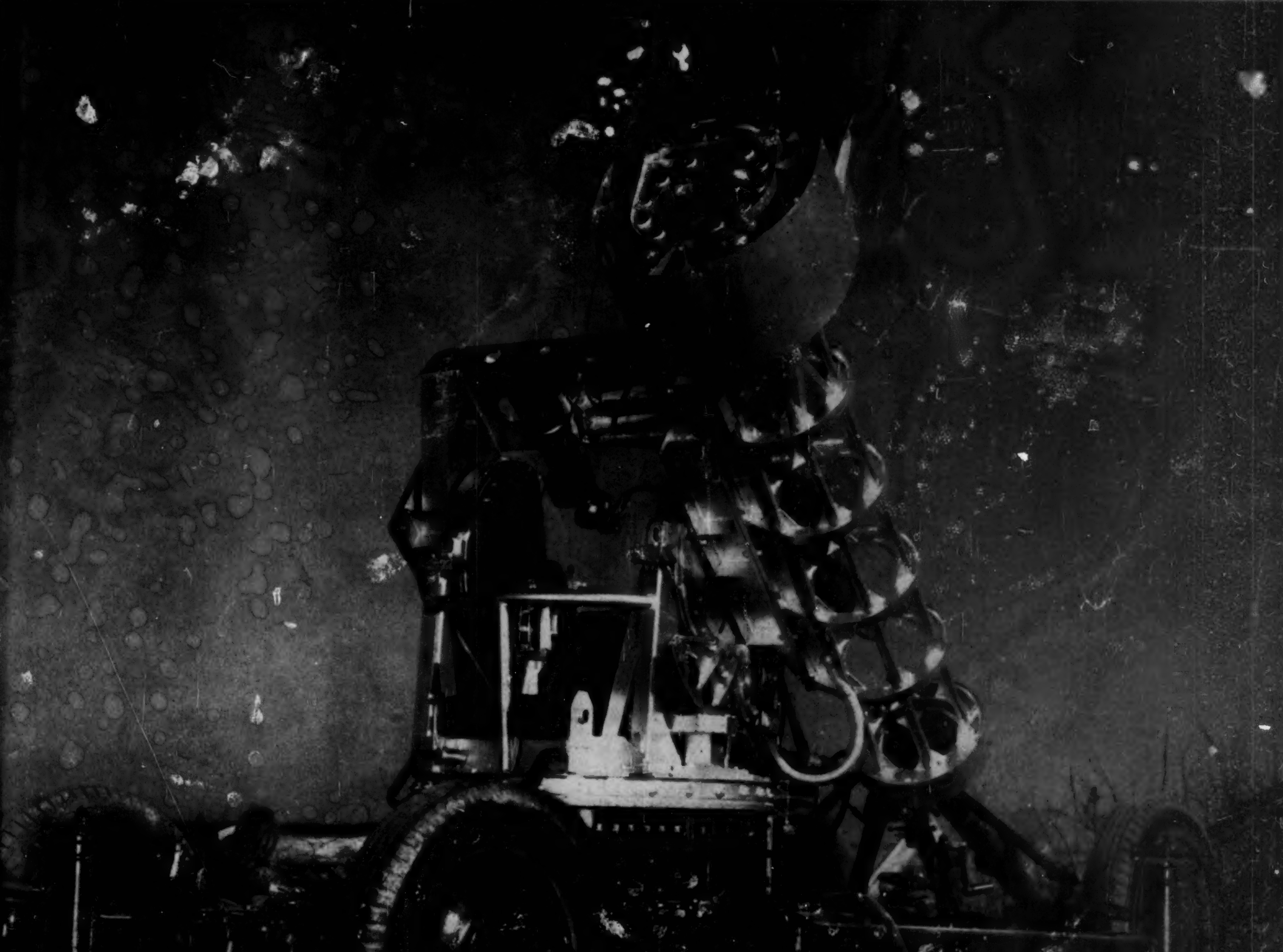
Sky and TELESCOPE



10-inch tracking telescope

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Vol. VIII, No. 12
OCTOBER, 1949
Whole Number 96
25 cents
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In This Issue:

LETTERS

Sir:

Naked-eye observations of 1st-magnitude stars and bright planets near the western horizon after sunset have been requested by Professor B. L. van der Waerden, Dutch mathematician, who is interested in Babylonian astronomy and therefore in obtaining some modern statistics with regard to the heliacal risings and settings of these bright objects.

The problem is to determine the conditions under which a bright object becomes visible or is lost in the twilight. Since Babylonian astronomy was practiced in a dry climate, observations from amateurs in the dry southwestern states, such as Texas, New Mexico, Arizona, and California, will be of particular value. While a regular program extending over half a year would by far be of most value, those for periods as short as one month could be used to advantage.

The observations would consist of noting on a series of clear nights, with as few gaps as possible, the names of the principal bright stars and planets seen near the western horizon after sunset, and also the names of the stars and planets which are not visible on a given night. Observe with the naked eye, perhaps with the aid of a cardboard tube, but without optical assistance. Note the general state of the sky, with special emphasis on cloudiness, haze, and humidity, and the possible disturbing effects of the moon. The date and approximate time of the observations, as well as the approximate latitude and longitude, should be recorded. Observations near the eastern horizon in the morning sky would be equally valuable.

On the basis of worldwide observations of this nature, Professor van der Waerden hopes to study the appearance or disappearance of a star or planet of given apparent magnitude as a function of the difference of azimuth between the sun and the object at the time of setting of the star or planet and the altitude below the horizon of the sun at that particular instant.

Professor Anton Pannekoek, the former director, now retired, of the Astronomical Institute at Amsterdam, is very much interested in seeing this work done. Observers interested in working on the project are requested to communicate their observations to Professor B. L. van der Waerden, Verlengde Engweg 10, Laren, North Holland, Holland.

BART J. BOK
Harvard College Observatory
Cambridge, Mass.

Sir:

The American Meteorite Museum has received via J. Fraser Paterson, of Broken Hill, New South Wales, Australia, a confirmation of earlier unverified announcements that the Wolf Creek crater discovered in 1947 has now been definitely pronounced a meteorite crater. (See **Sky and Telescope**, May, 1949, page 163.) Its true nature is said to have been verified by the finding of meteorites around its rim. Mr. Paterson forwarded a copy of the magazine **Conveyor** for February, 1949, containing an article by Dr. Frank Reeves, a geologist for the Vacuum Oil Company, on "Western Australia's Wolf Creek Crater."

The great importance of this discovery stems from two facts. It is the second largest meteorite crater so far definitely proven by the finding of meteorite fragments on its rim. Measuring approximately 3,700 feet from rim crest to rim crest, it closely rivals the great Barringer crater of Arizona.

Secondly, this is the only large crater so far discovered that has been produced by other than the siderite type of meteorite. It is said that the specimens found are of the iron-stone type. Only the small (55 by 36 feet) Haviland crater in Kansas had previously been credited to this type of meteorite.

An interesting observation on the Wolf Creek crater, as studied from photographs and the notes made by scientists who have visited it, is that it more closely resembles the craters of the moon than do our other known examples. The ratio between its rim elevation (as reported by Dr. Reeves) and rim-to-rim diameter, as measured on the aerial photograph reproductions examined, is approximately 46, whereas the ratio between these features of the Arizona crater is about 27.6.

The crater is said to have been formed in pre-Cambrian micaceous sandstone, which is probably not tougher than the Kiabab limestone which met the Arizona meteorite. A reasonable explanation for the broader, shallower form of the Wolf Creek crater would seem to be that the brittle stony constituents of the iron-stone type of meteorite rendered it less coherent under the strain of impact so that it exploded before penetrating so great a depth of sediments. On the other hand, its velocity was sufficient to occasion an equally violent explosion, the energy of which was expended laterally to produce a wide shallow pit rather than a deep narrow one.

H. H. NININGER
American Meteorite Museum
Winslow, Ariz.

Sky and TELESCOPE

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CONTENTS

COVER: A 10-inch Newtonian telescope on a modified M-45 mount, used by the Ballistic Research Laboratories for tracking V-2 rockets and guided missiles. The effective focal length may be varied between limits of 18 and 40 feet. Ordnance Department photograph. (See page 299.)

BACK COVER: The nebula surrounding the open cluster NGC 2244, photographed with the 48-inch Schmidt telescope on Palomar Mountain in blue light, exposure 30 minutes on Eastman 103aO emulsion. The reproduction scale is one millimeter to about 31 seconds of arc. South is at the top; east at the right. The brightest parts of the nebula are known as NGC 2237, 2238, and 2246, according to Dr. R. Minkowski, in an article discussing this object in the August, 1949, issue of the **Publications** of the Astronomical Society of the Pacific. Mount Wilson and Palomar Observatories photograph. (See In Focus.)

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RECENT PAPERS and articles have given a fair indication of the progress made in the field of guided missile research and development by government and contracting agencies. To present a comprehensive review of up-to-date achievements in this readily defined but widely spread field would be a task indeed. In particular, it would be difficult to report adequately on all related work which often is found to be no less interesting than the technical guided missile problems themselves.

At the White Sands Proving Ground, near Las Cruces, N. M., full-scale flight testing of guided missiles is conducted by the Army Ordnance Department in collaboration with other departments of the armed services. A variety of experimental work is carried on, including measurements of the flight to study the missile's aerodynamic properties and the functioning of its guidance and control mechanisms, as well as research in which the missile acts as the observing station.

The responsibility for the flight measurements is carried by the Ballistic Research Laboratories at Aberdeen Proving Ground, Md. Here, theoretical and experimental work on observing methods and instrumentation is carried on, for ultimate testing and application on the White Sands range. There, on the desert floor and bordering mountains to the east and west a network of observing stations has been established and continues to grow northward from the launching site.

The variety of data which must be obtained, the requirements of accuracy, and time limits which must be met under difficult observing conditions present a considerable task. For scientific and technical reasons, and also in consideration of the cost of the entire missile project, it is necessary to employ different and preferably independent methods whenever possible. Thus one finds both ground and missile-borne instrumentation, of optical as well as electronic types, operating synchronously in systems, semi-independently, or entirely independently, and always in relation to a common timing system.

A brief description of some of the optical instrumentation may serve to illustrate the activities of the Ballistic Research Laboratories in this field. Again, the problems requiring a solution are easily defined: For all types of missiles scheduled for testing at White Sands Proving Ground, the trajectory of the missile as well as its attitude in

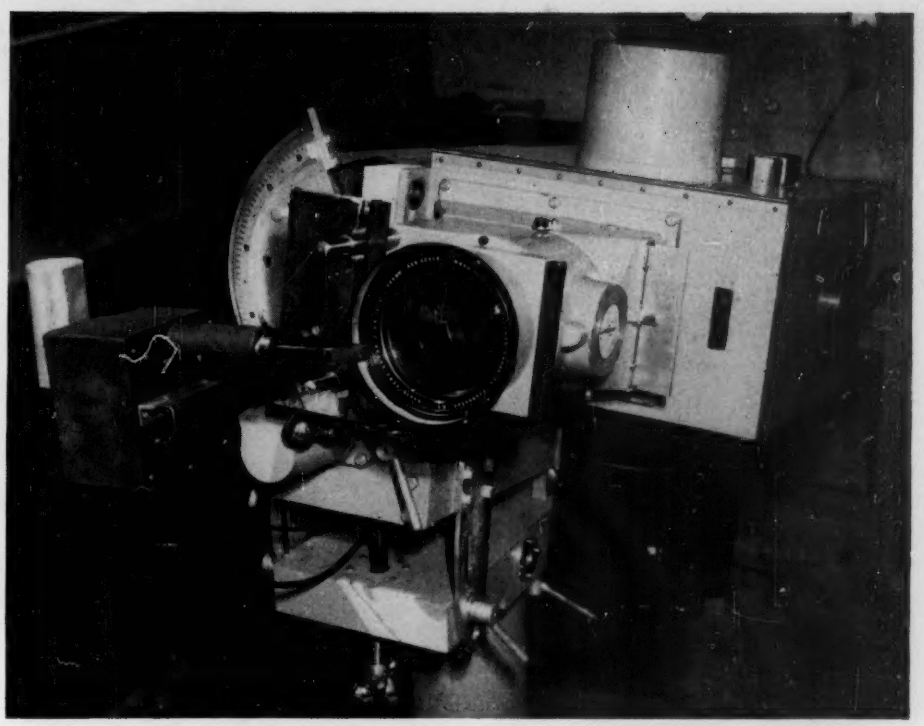
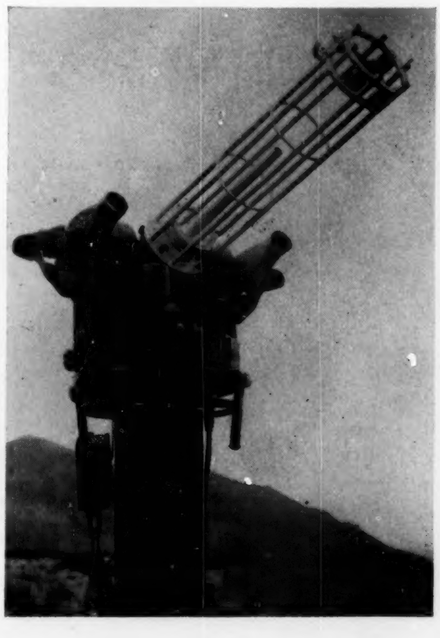


Fig. 1. Bowen-Knapp camera with timing device. Exposures are of 1/10,000-second duration, and may be taken at rates between 30 and 180 per second, the corresponding field sizes being 5¼ by 0.9 and 0.15 inches, respectively. The instrument may be equipped with either a 7-inch or a 12-inch focal length lens. All photographs from Ballistic Research Laboratories.

Optical Instrumentation for Guided Missiles

BY DIRK REUYL, *Ballistic Research Laboratories Aberdeen Proving Ground*



(Left) Fig. 2. Askania cinetheodolite, modified with Cassegrainian optical system of 15 feet focal length. Exposures may be four per second, with simultaneous recording of azimuth and elevation of the optical axis.

(Right) Fig. 3. Ballistic camera, plate size 8 by 10 inches. It has double rotating shutter and sky-screen to reduce sky background. The direction of the optical axis and lens distortion are determined from night photographs of the stars.

Fig. 4. A ballistic camera record of an A-4 missile (V-2) showing the sequence of images of the rocket and its vapor trail.

flight must be determined. The measurements must include the space co-ordinates of the missile as well as its yaw, pitch, and roll angles as functions of time.

At the point of take-off and for the first portion of the trajectory, some two to three thousand feet, the use of fixed motion-picture cameras is profitable. Instruments designed especially for wide-field coverage and differing radically from the conventional movie camera types are being used (Fig. 1). The position of the missile in space is obtained by triangulation from different stations forming a set. The accuracy of such measurements is given by a probable error of six inches when the stations are located at distances of about one mile from the launching site.

Once the missile has moved beyond the region covered by these instruments, its path is charted by tracking cinetheodolites, equipped with both visual and photographic optical systems and recording automatically azimuth and elevation of the optical axis at each instant of exposure (Fig. 2). Different types of instruments with focal lengths of 12 and 24 inches are being used, the shutter functioning being controlled from a central point, to insure synchronism. In angular precision these instruments approach an accuracy of about 20 seconds of arc, and the process of measurement of films and reduction will yield a trajectory in a few days. Under favorable conditions a single instrument has recorded the complete trajectory of an A-4 missile, whereas a set of instruments in general will give good results to an altitude of at least 50 miles. A vacuum trajectory may well be calculated from this point on, and a small correction for slight residual air resistance applied, if desired.

Whereas this instrumentation is useful for providing rapid trajectory data, it will not meet all accuracy requirements. Hence a system of stationary plate cameras is being developed (Fig. 3). These are calibrated by means of star positions and will be capable of giving angular precision to a maximum of two seconds of arc. The analysis of initial tests shows a high degree of internal agreement between the observations, given by probable errors of the space co-ordinates of the order of a foot at an altitude of 20 miles.

The trajectory measuring methods described so far can be applied without great difficulty; in fact, the largest operational problems are presented by desert conditions which affect all observing activities in much the same way. It is clear, however, that because of modest focal lengths these instruments will not furnish much detailed information about the attitude of the missile (Fig. 4), nor about special occurrences, such as separation of booster rockets, ejection of experimental apparatus, functional failures, and so on. To meet these demands the development of long-focus tracking instrumentation was undertaken. The first instrument, of a design determined more by the pressure of time than any other factor, consisted of a 4.5-inch refracting telescope equipped with an enlarging system to give an effective focal length of about 20 feet.

Fig. 5. Twin 4.5-inch tracking telescope on modified M-45 mount. The effective focal length may be varied from 15 to 35 feet, and 35-mm. pictures taken at rates up to 20 exposures per second.

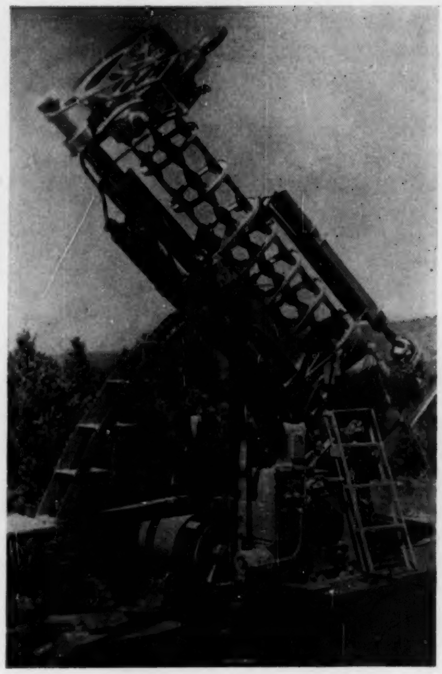


Fig. 6. 16-inch tracking reflector on modified 90-mm. mount, effective focal lengths 40 to 80 feet. The instrument is located 40 miles from the launching site, at an elevation of 8,000 feet. Note the observer at the guiding telescope.

Mounted on a modified M-45, 50-caliber gun turret, it can record at a maximum rate of 20 exposures per second on standard 35-mm. motion picture film. Experience gained with this instrument has led to new designs, but the first instrument is still in operation, as a twin telescope (Fig. 5) and with some further minor modifications. The second instrument which has been developed is mounted on essentially the same mounting, but consists of a 10-inch f/8 Newtonian photographic system (see front cover) with amplification to a maximum effective focal length of 40 feet. This instrument has proven to be very successful and more of its type have been built, for White Sands as well as other ranges.

Meanwhile, continued mount and tracking studies have led to the development of a 16-inch instrument (Fig. 6), also of Newtonian type, on a modified 90-mm. gun mount, and with an enlarging system capable of giving effective focal lengths from 40 to 80 feet.

Several instruments have been equipped with devices to distribute the optical beam for dual-purpose use, for example, for additional spectrographic studies.

The orientation of the missile axis in space, as well as the missile roll, may be determined by instruments of this type with rather good accuracy. At a medium focal distance of 20 feet, the A-4 axis orientation has been measured with a probable error of 0.6 degree at an altitude of 20 miles (Fig. 7). Complete trajectory records, showing missile

detail throughout the flight, are common occurrences. It may be pointed out that partial failures are hardly ever caused by the optical system, but rather by the difficulties of tracking. In spite of the relatively low tracking rates, achieved by wide spreading of the station net, the small angular field presents a large problem to the engineer as well as to the tracking operator.

The various types of optical instruments developed for use in full-scale free-flight ballistic measurements of guided missiles have shown their usefulness. Moreover, and perhaps more important, they have shown, in the process of experimentation, in which direction further work must progress. Investigations of tracking methods are being continued. A twin 10-inch Cassegrain instrument, with a 16-inch alternate system, mounted on a modified radar pedestal, is under construction. It will be equipped with advanced features of tracking control, and have beam-distributing devices for triple-purpose use. Coincidentally, studies are in progress for the development of semiautomatic film-measuring techniques as well as the application of high-speed computing devices. Ultimately, one may hope to achieve real push-button observing, where tracking of the missile, data transmission, and flight data calculations are all carried out automatically, as-the-missile-flies, for several methods of observing.

Fig. 7. Sample frames at 10-second intervals of a tracking telescope record of an A-4 missile during the period of propulsion, showing changing jet structure. The corresponding slant ranges are 8, 9, 10, 15, and 20 miles.

The further development of observing methods and instrumentation will be governed by the trends of research in the entire guided missile field. Many new problems are anticipated which will demand the continued interest and enthusiasm of those engaged in research on methods of ballistic measurement of full-scale guided missiles in flight.

NEWS NOTES

By Dorrit Hoffleit

LICK OBSERVATORY ACQUIRES 120-INCH MIRROR DISK

In 1933, Corning Glass Works poured a 120-inch pyrex mirror blank intended to be used in testing the 200-inch mirror which was cast two years later. Because the testing procedure was changed, however, the 120-inch disk was never used, and now Lick Observatory of the University of California has acquired it from California Institute of Technology. This puts the 120-inch telescope project on Mt. Hamilton approximately two years ahead of schedule. Design work on the new instrument has been under way for three years (see *Sky and Telescope*, January, 1947), under the direction of Chief Engineer Wilbert W. Baustian. Bids for construction of the instrument can now be requested, and a site for the telescope has been selected on Mt. Hamilton, where preliminary excavation of an exploratory nature has already been made.

The 120-inch disk is a remarkably homogeneous and uniform piece of glass. Like the 200-inch, it is not solid but has a honeycomb-back structure. The upper plate is four inches thick; together with the ribs the total thickness is 16½ inches. The total weight is 8,500 pounds, or 4¼ tons. An 8-inch hole will be provided in the finished mirror to admit light to an observing station directly behind the mirror.

The decision to purchase the 120-inch disk from Caltech was not made until results of the extensive tests of the finished 200-inch mirror were available. These indicate that in the case of the smaller mirror a satisfactory system of supports can be constructed even though at the center the parabolic curve will reduce the four-inch thickness by 1½ inches.

At the end of August, the 10-foot disk was to have been trucked from Pasadena to San Jose, where it is to be held in storage until it can be brought to its own observatory dome on Mt. Hamilton, where the grinding, polishing, and figuring will be done. Provision will be made in the dome for testing the mirror in both horizontal and vertical positions, as well as in the telescope itself.

EMISSION OBJECTS IN GALAXIES

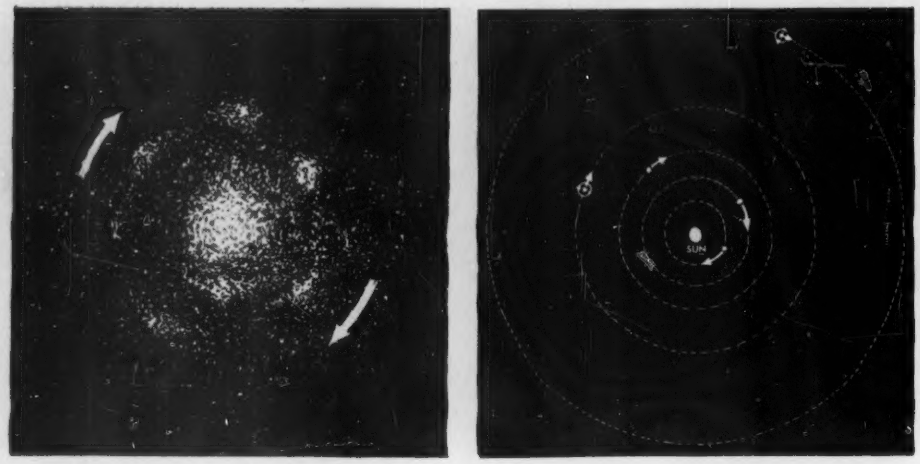
At the National Astrophysical Observatory, Tonanzintla, Mexico, Dr. G. Haro (director of the National Astronomical Observatory at Tacubaya) has found a dozen objects with bright hydrogen-alpha emission lines on objective-prism spectra of our neighbor galaxy in Andromeda, M31. Of these, four were previously known as emission objects, five are apparently new, and three are objects previously tentatively listed as globular clusters by Mount Wilson observers. The three objects, and their photographic magnitudes by Seyfert and Nassau of the Warner and Swasey Observatory, are Baade 254 (15.56), Hubble 34 (16.89), Baade 203 (17.86). A score of other objects from the Mount Wilson lists, brighter than 16.5 magnitude, however, do not show hydrogen-alpha bright. No other emission-line objects appear in the surrounding field of 20 square degrees.

Globular clusters in the Milky Way galaxy are free of the luminous hydrogen gas that produces hydrogen emission, and their absolute magnitudes are considerably greater than those of the questionable objects in the Andromeda galaxy. It may be, therefore, that those with hydrogen emission are nebulous open clusters, like the Pleiades, or giant planetary nebulae. In the Magellanic Clouds, Shapley has found both of these types of object, and their absolute magnitudes are similar to those of the emission-line objects in M31.

The Tonanzintla Schmidt with its 26-inch objective prism has also been turned on the galaxy in Triangulum, M33, by Dr. Haro. Forty-one bright hydrogen-alpha objects have been found, of which 25 were already known (Mayall and Aller). The exposures on the Tonanzintla spectrum plates range from 60 to 75 minutes.

OPTICAL SOCIETY OF AMERICA

The 34th annual meeting of the Optical Society of America will be held at the Hotel Statler, Buffalo, N. Y., on October 27-29. A symposium on microscopy and microscope design is one feature of the meeting. Invited papers will be presented on recent developments in infrared spectroscopy, newer techniques in spectrochemical analysis, vision, and physical receiving devices, and new applications of interferometry.



1755 — Kant's theory has a clotting mass of gas and dust in rotation, the clots growing by accretion to form planets and satellites. The remainder of the nebula contracts to form the sun.

New Trends in Cosmogony

By Otto Struve, *Yerkes and McDonald Observatories*

OF ALL the many problems of astronomy the most fascinating, by far, is the study of the origin and evolution of the solar system. Undoubtedly every astronomer, no matter what his own special work may be, has thought about it and has weighed in his mind the advantages or disadvantages of the different hypotheses. More than that, he has probably been hoping to contribute, directly or indirectly, to its solution. But the purpose of this article is not to review the hypotheses. That has been done quite recently by Thornton Page, in an article in *Physics Today* (Vol. I, No. 6, October, 1948). Instead, I shall discuss what appears to me to be a small revolution in our process of thinking about this problem and in the manner in which we attack it.

As astronomers, we often pride ourselves with being the disciples of the oldest among the physical sciences. This has its advantages, but it also brings with it a tendency to become steeped in tradition. When Immanuel Kant, in 1755, laid the foundations for all later cosmogonical speculations, a great deal was known about the properties of the solar system, but hardly anything about the fixed stars. It was natural, then, to concentrate upon trying to explain the regularities which had been observed among the orbits of the planets, their rotations, their satellites, and so on. Many of these regularities cannot be due to chance. For example, the fact that the planets all move in the same direction, and that they lie nearly in one plane, must be a consequence of the manner in which they were formed. Most later workers continued Kant's efforts to explain these regularities by inventing a suitable primordial medium, such as the hot, spinning and contracting nebula of Laplace; or by postulating an appropriate event, such as the close passage of another star in the theories of Moulton and Chamberlin, of Jeans, and of Jeffreys. The hypothetical media and their properties, and the catastrophic events, were adjusted in such a way as to permit their authors to deduce many, if not all, the observed properties of the solar system.

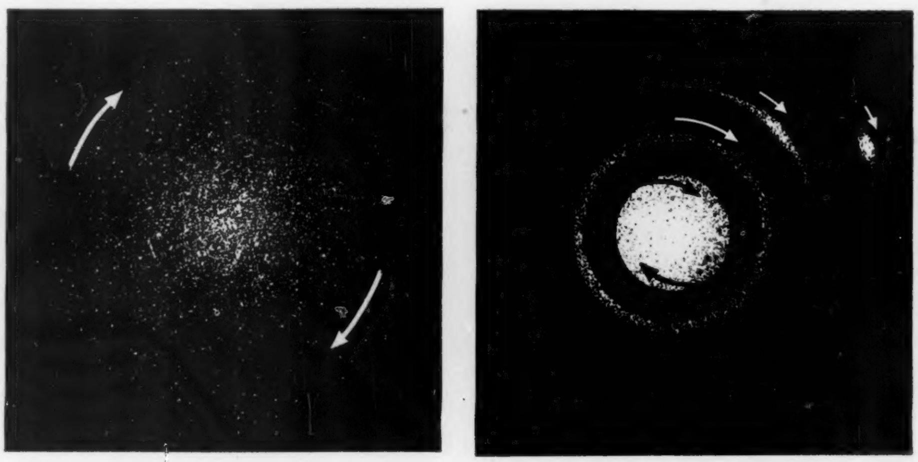
In the earlier stages this was a perfectly reasonable procedure. No one knew whether formations of the kind Laplace and others had proposed really existed in the galaxy, or whether events of the type considered by Moulton and Chamberlin actually took place among the stars. One could always take refuge in the thought that the formations and the events *could* have existed; and even if future observations should ultimately fail to produce them, there was always the comforting excuse that, for all we knew, the solar system might be unique in our universe!

But gradually astronomers began to study the fixed stars. In 1838 the first stellar distances were determined, and 50 years later the "local swimming hole" of our galaxy — that is, the region of space surrounding the solar system to a distance of about 300 light-years — had been fairly well explored. Then, in 1912, came Russell's great advance which culminated in the construction of the H-R diagram (see *Sky and Telescope,* August, 1949, page 250). The more we learned about the stars, the more we realized that the sun is a fairly normal star of the main sequence — a relatively cool dwarf — having about the usual values of the three principal parameters, mass, radius, and luminosity.

If we imagine an astronomer about 300 light-years from where we are now, and let him observe the sun from that distance, it would appear to him as an inconspicuous, single star of apparent magnitude 7, having a pronounced reddish color and a surface temperature of about 5,700° K. He should be totally unaware of the existence of any of the planets, not to speak of the comets, asteroids, zodiacal light, or corona. With a spectrograph he would be able to determine that this inconspicuous little star has no perceptible rotation around its axis — less than 10 kilometers per second at the equator, which is about the limit that present-day instruments will reveal. However, some clever photoelectric observer might conceivably find

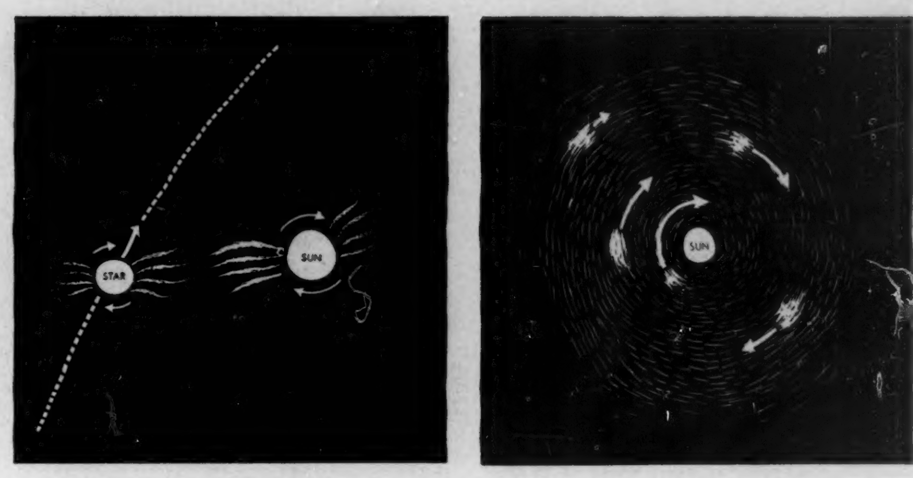
THE ILLUSTRATIONS

with this article are reproduced, by permission of the editor, from the October, 1948, issue of the magazine, Physics Today, published by the American Institute of Physics. These drawings illustrated an article by Dr. Thornton L. Page, of the University of Chicago, on the origin of the earth.



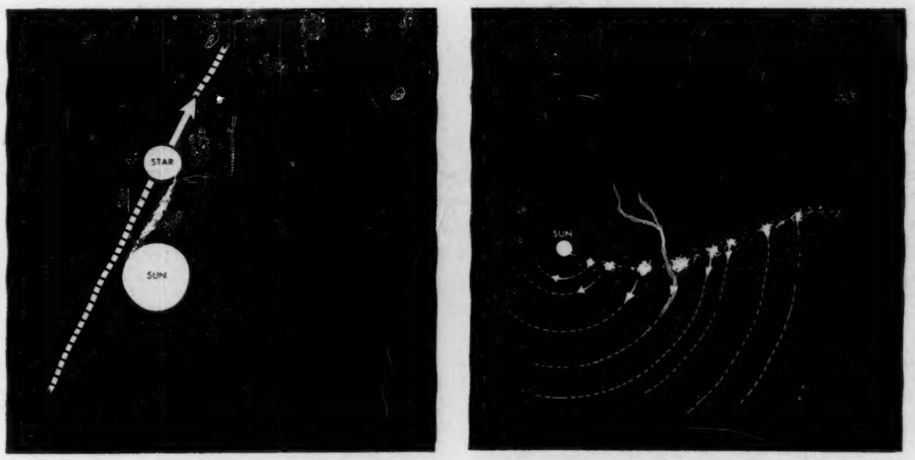
1796 — Laplace's theory starts with a rotating nebula of hot gas that cools and shrinks. It spins faster and leaves rings of gas to condense into planets, the whole remainder forming the sun.

a small variation of the total light of the sun (when there happens to be a large and unusually persistent sunspot), and from the temporary periodicity (because the spot finally disappears) of about one month, he might suspect that the actual velocity of the sun's rotation at the equator is only two kilometers per second. This result would not disturb him: he would know that all the rest of the cool dwarfs which are not members of close double-star systems have equally small rotations. If he knew anything at all about the cosmogonical theories of our predecessors, he would probably immediately discard those which attribute the origin of the planets to a rapidly rotating star of the solar type. There just aren't any such stars among the hundreds of millions of cool dwarfs in the galaxy.



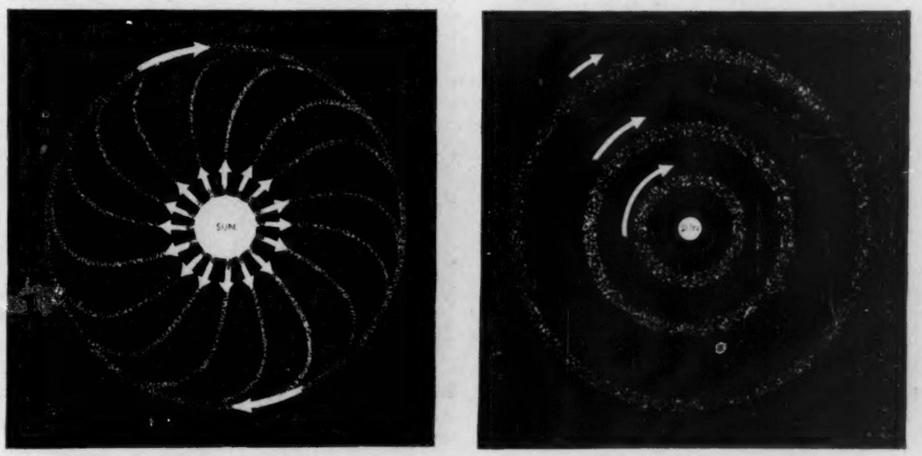
1900 — The Chamberlin-Moulton theory pictures a passing star narrowly missing the sun, causing huge eruptions on both stars. The sun is left with a vast number of planetesimals condensed from the erupted gases and slowly coagulating to form planets. The intruding star should also have had planets form.

We see that the study of the stars must have a bearing upon the development of cosmogonical thought. Since all those properties of the sun which we can observe in other stars are normal for a large group of reddish dwarfs, it is, at least, plausible that those other properties that we cannot now test outside the solar system are also common to all or most of them. In other words, it is far more reasonable to start with the working hypothesis that planets are normally present in the vicinity of cool dwarfs, than it is to suppose that our planetary system is unique, or very rare. But if we make this assumption, we are immediately led to consider the evolution of the sun and its system of planets in the light of what we know, or surmise, concerning the evolution of the stars in general. For example, it is no longer reasonable to think of the sun as being surrounded by a nebulous mass of sufficiently high density to produce all the planets and at the same time permit about 99 per cent of its substance to escape to infinity, because such a nebula, if it existed in the vicinity of other red dwarfs, would produce marked absorption effects in the spectra of the transmitted light from those stars. On the other hand, we know that more tenuous gaseous rings are frequently present in stars of high temperature and of large axial rotation. They also abound in close binary systems. Accordingly, we should satisfy, as nearly as is possible, not only our desire to explain the observed regularities in the solar system, but also the observed properties of stars and nebulae in various stages of their evolution.

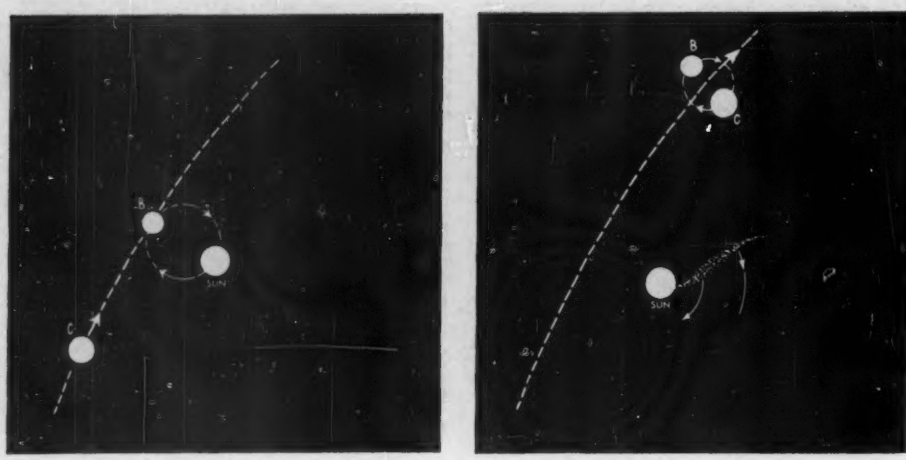


1917 — In the Jeans-Jeffreys theory, a sideswiping star tears out a long filament of gaseous material that is expected to cool and condense into planets, the largest in the middle and the smaller ones at either end.

This has required breaking with the old tradition and departing entirely from the conventional form of cosmogonical research. The transition was not an easy one, and it required a great deal of time. But gradually astronomers in several countries made the break. In Germany, C. F. von Weizsaecker adapted the theory of turbulence to ordinary stars, and tried to explain why the hot stars have, on the average, large rotational velocities, while the cool stars have very slow rotations. Another step in the same direction was made in my Vanuxum lectures at Princeton University in March, 1949, which are to be published in book form by the Princeton University Press. In Russia, V. A. Ambarzumian has especially stressed the departures from traditional cosmogony, and V. G. Fessenkoff has just published



1930 — In Berlage's theory electrically charged atoms and molecules shot out from the sun spiral in the solar magnetic field. Concentric rings of gas might result, each ring formed of atoms or molecules with the same ratio of charge to mass, as had been calculated by Birkeland in 1914.

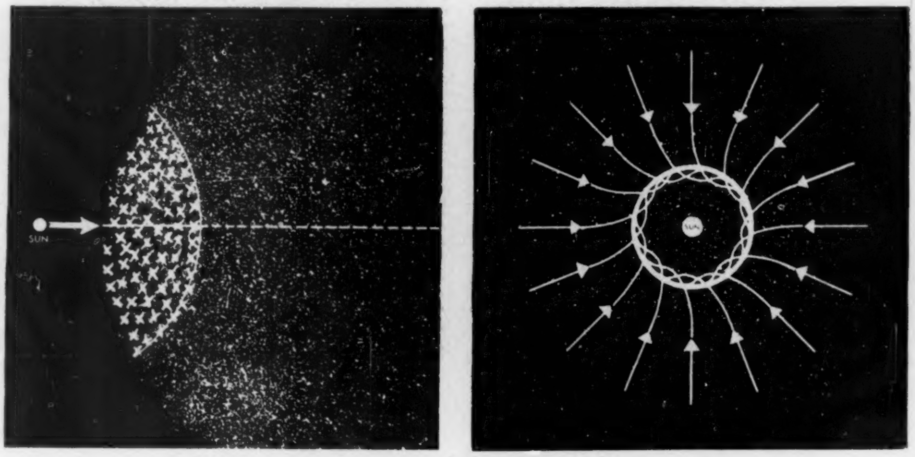


1936 — Lyttleton suggested that if the sun were originally a close double star, a third star, C, might have carried the sun's companion away with it, leaving a filament of gas moving around the sun. The filament would have sufficient angular momentum to account for that of the planets today.

a review of the present status of the problem of the origin of the solar system. He is primarily concerned with the past history of the sun itself.

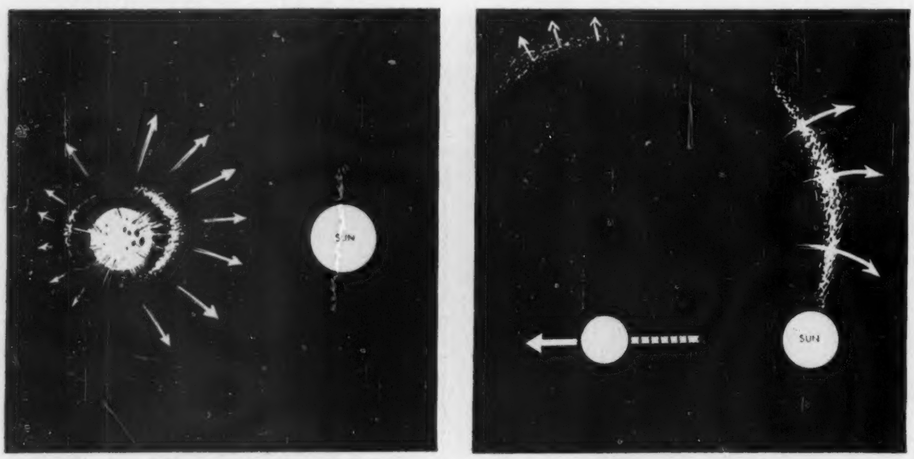
What kind of a star was the sun several billion years ago? Undoubtedly, it contained more hydrogen and less helium — in accordance with the Bethe-von Weizsaecker theory of the source of solar energy. But it was probably also more massive, because most stars appear to be losing mass not only by radiation (which is insufficient), but also by the ejection of prominences, or extended atmospheres. It must be remembered, of course, that not many years ago Hoyle and Lyttleton advocated the opposite process to explain the evolution of the stars, namely, the growth of their masses by the process of sweeping up interstellar matter. It is not unlikely that both processes exist simultaneously, and that the latter predominates in regions of high interstellar density, while the other takes over in empty regions of galactic space. At any rate, Fessenkoff assumes that the loss of mass in stars by what he calls "corpuscular radiation" is proportional to the luminosity. If Bethe's theory of the transformation of hydrogen into helium is correct, then it is possible to estimate that four or five billion years ago the sun must have had about 10 times its present mass and about 20 per cent more hydrogen than it has now. If the planets were already in existence at that time all of their orbits must have been 10 times smaller in radius than at present, because, according to Sir James Jeans, the product of the mass of the sun and the semimajor axis of a planet's orbit remains approximately constant, as the mass of the sun changes.

An interesting consequence of this theory is the fact that four billion years ago the angular momentum of the sun must also have been much larger than it is at present. The angular momentum is a measure of the quantity of rotation in a body, or a system of bodies, and is expressed as the product of the mass, the equatorial rotational velocity, and an appropriately taken average value of the distance of each infinitesimal particle from the axis. This quantity remains constant if the body, or system of bodies, is left to itself. For example, if the body expands, the average distance of the particles from the axis increases and, in order to keep the product constant, the rotational velocity must decrease.



1942 — Alfven proposed that in the course of its journey through space the sun passed through a gaseous nebula, its presence creating electric charges on the atoms of gas. The charged atoms spiraled inward to form rings of gas, such as that shown here, which may later have condensed into planets.

In the case of the sun, according to Fessenkoff, surface layers are constantly being dissipated into space. These outermost strata carry with them most of the angular momentum. Hence the sun loses not only mass, but also angular momentum. It is possible to compute backwards and find how fast the sun was spinning around its axis at any previous time. It turns out that during the past two billion years the rotational velocity changed very little. But between three and four billion years ago the change was rapid. When the sun had 10 times its present mass its rotational velocity at the equator must have been several



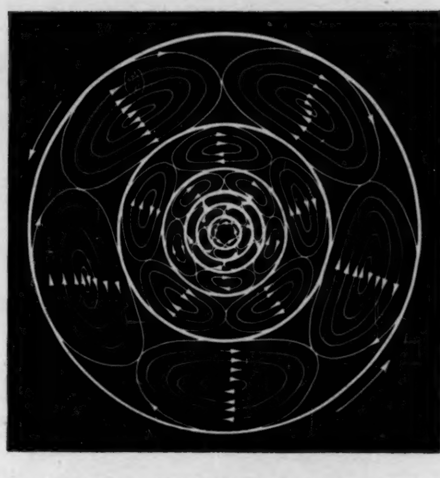
1944 — Hoyle's theory is that a star near the sun might have blown up, throwing off a large shell of material, possibly more in one direction than in others. Nova explosions are frequently observed to do this. While the nova recoiled away from the sun due to the one-sided explosion, part of the nova shell could be caught by the sun's gravitational field. Development then would be similar to the original Jeans-Jeffreys theory.

hundred kilometers per second; the corresponding angular momentum of rotation might well have been some 18,000 times greater than its present value, and several hundred times greater than the total angular momentum of the entire solar system, including the momentum of the orbital motions of the planets (which now constitutes about 98 per cent of the entire momentum).

Apparently, Fessenkoff attributes the origin of the planets to the time when the sun had such a large rotational velocity that it was unstable at the equator, its force of gravity being insufficient to prevent the outermost layers from detaching themselves by the action of the centrifugal acceleration. The exact mechanism of planet formation is not described, but we can perhaps think of a process similar to that described by von Weizsaecker, in which a fairly dense disk-shaped nebula permits the condensation of a small fraction of the available substance into planets, while most of the lighter gases, especially hydrogen and helium, are diffused outward until they are lost in interstellar space.

The minor planets are explained as the result of an explosion of a large former planet, with part of the debris probably also lost from the solar system. The explosion may have occurred as the result of a close approach to Jupiter, at the time when the solar system was much smaller than it is now.

These and other details are in part taken over from older theories, but the attempt to attribute the origin of the planetary system to a definite, early stage in the evolution of the sun as a star is new. The proposed evolutionary path, along the main sequence from top to bottom, is reminiscent of Russell's own early ideas of stellar evolution. In this respect Fessenkoff's hypothesis resembles some of the hypotheses recently advanced in this country. We know from statistical studies of the stellar population in our Milky Way system that the overwhelming majority of the stars belong to the main sequence. It is difficult to think of a physical process which would permit them to evolve across the main sequence, since any such process would of necessity produce a large accumulation of stars in some other part of the H-R diagram. No such accumulation has been found; even the white dwarfs are not sufficiently numerous to serve as a "sink" into which all fully evolved main-sequence stars might drop. It is more plausible that the path is along the main sequence, and that the red dwarfs constitute the region in which the "old" and "worn-out" stars finally accumulate.



1945 — Von Weizsaecker, in a return to the Kant hypothesis, suggests the formation of vortices in the equatorial plane of a nebula of dust and gas rotating about the sun. Accretion taking place along the heavy concentric circles would form planets and satellites with direct rotation and revolution, spaced in geometric progression from the sun.

It is necessary to be constantly aware of the fact that we know very little about the evolution of the stars, because we observe only an infinitesimal fraction of a star's life span. It is as though we were expected to reconstruct the entire evolution of man after having been given a glimpse of a child during one second! But we are helped by the fact that in all probability there are now in our galaxy some stars which are billions of years old, while others may only have existed a few million years. Similarly, our hypothetical observer would be greatly enlightened if during his one-second survey of humanity he could see not only one child, but a large number of persons of different ages. He would still be faced with the problem of arranging the characteristic features of the specimens of his observation in an evolutionary sequence, and of deciding in which direction the evolution proceeds; but with some perseverance and some luck he might expect to solve his problem.

TERMINOLOGY TALKS — J. Hugh Pruett

More on Sunspot Numbers

Here we wish to correct an error in Terminology Talks of August, 1949, page 245. There, in the formula for the sunspot number, $N = k\ (10g + f)$, g was defined as the number of spot groups which are observed. Since the word "group" is used, and this implies two or more, a single spot could not be a group, it seems. A careful inspection of many texts and other books on astronomy convinces me that the majority assume the meaning just given. Some say so definitely and others imply it by emphasizing how much more important in N is a group of spots than a spot standing alone. For that reason g is multiplied by 10. I had this idea when preparing the August article. Some writers state the formula, but avoid giving definite explanations — or else they make vague, ambiguous statements.

I have recently been reviewing for my newspaper syndicate Dr. Donald H. Menzel's new book, *Our Sun*. At one point I was suddenly surprised, for on page 112 he states:

"Spots may occur either singly or in groups. g is the number of disturbed regions, either groups or spots. f is the total number of individual spots. k is the factor depending upon the observer and the size of his telescope.

"Let us see how this procedure works. You note, let us say, two groups each consisting of two spots, and one isolated spot. Thus $g = 3$ and $f = 5$, which give $f + 10g = 35$."

There is nothing vague about this. The method described in our August Talks would give 25. Commenting on the procedure, Dr. Menzel says:

"I believe that the spot numbers give far too much weight to the smaller disturbances. A large, bipolar group, seen as the only disturbance on the sun, would have a number of 12. Add a single small spot somewhere on the surface and the number jumps to 23, a change that amounts to almost a factor of two. The system is decidedly artificial. I should recommend replacing it completely were it not for the historical value of the series. A somewhat better and certainly more objective index of solar activity is the total area of all spots, umbra and penumbra, as determined at Greenwich from photographic records."

In *Popular Astronomy* for March, 1947, Dr. Robert S. Richardson, of Mount Wilson Observatory, notes: "g is the number of individual spot-groups upon the disk, f is the number of individual spots counted within the groups." An inquiry by letter to Dr. Richardson brought the prompt response that "a single isolated spot would count as a group. If there is one group of only two spots and an isolated spot elsewhere, the value of N (neglecting k) is 23 and not 13."

Dr. Richardson, too, thinks this system is not ideal. Quoting from his letter, "A big stable unipolar spot will dwarf a small active group; but the smaller group may be much more influential in causing terrestrial magnetic disturbances."

References to a recent Zurich headquarters statement, and all the way back to *The Sun*, by C. A. Young in 1883, regarding the formula, convince the present writer that g stands not for groups alone in the ordinary sense but for the total number of centers of disturbance, either collections of spots or single spots.

AMERICAN ASTRONOMERS REPORT

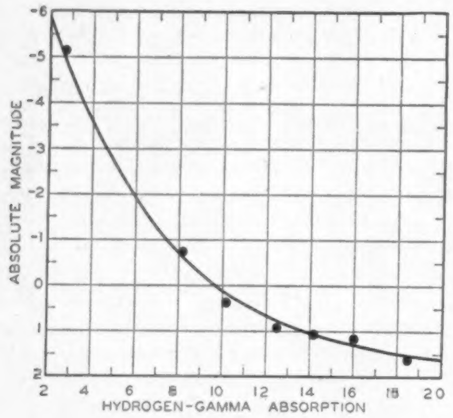
Here are highlights of some papers presented at the 81st meeting of the American Astronomical Society at Ottawa, Canada, on June 19-22. Complete abstracts will appear in the Astronomical Journal.

Absolute Magnitudes of A-type Stars

DETERMINATION of that important characteristic of a star, its absolute magnitude, has been made by Dr. R. M. Petrie and C. D. Maunsell, of the Dominion Astrophysical Observatory, for 165 stars in the spectral region *B*8 to *A*3. The luminosity range was from absolute magnitude −6, the supergiants, to +3, the normal dwarfs.

These relatively hot, white stars are noted for the prominence of the hydrogen Balmer lines in their spectra, and the Canadian astronomers have used the variation in the intensity of the violet hydrogen-gamma line (wave length 4340 angstroms) to determine the absolute magnitudes. A tenfold increase in hydrogen absorption is measured from the supergiants to the dwarfs. The white dwarfs are not included in this behavior.

Comparison of magnitude estimates made in this manner with those derived from trigonometric, spectroscopic, dynamical, and cluster parallaxes indicates that the equivalent width of the hydrogen-gamma line is a reliable measure of a star's absolute magnitude and, hence, of its distance.



By means of this curve, the hydrogen-gamma absorption in a star's spectrum may be used to predict its absolute magnitude. Intrinsically faintest stars (the dwarfs) are at the bottom.

Milky Way Surveys

A SEARCH for stars of high luminosity in a continuous belt six degrees wide on either side of the galactic equator has been undertaken with the 4-degree objective prism attached to the Schmidt telescope of the Warner and Swasey Observatory. The survey extends from galactic longitudes 347° to 184°. It is being carried out jointly by Dr. J. J. Nassau, Case Institute of Technology and director of the observatory, and Dr. W. W. Morgan, of Yerkes Observatory. It is financially supported by the Office of Naval Research.

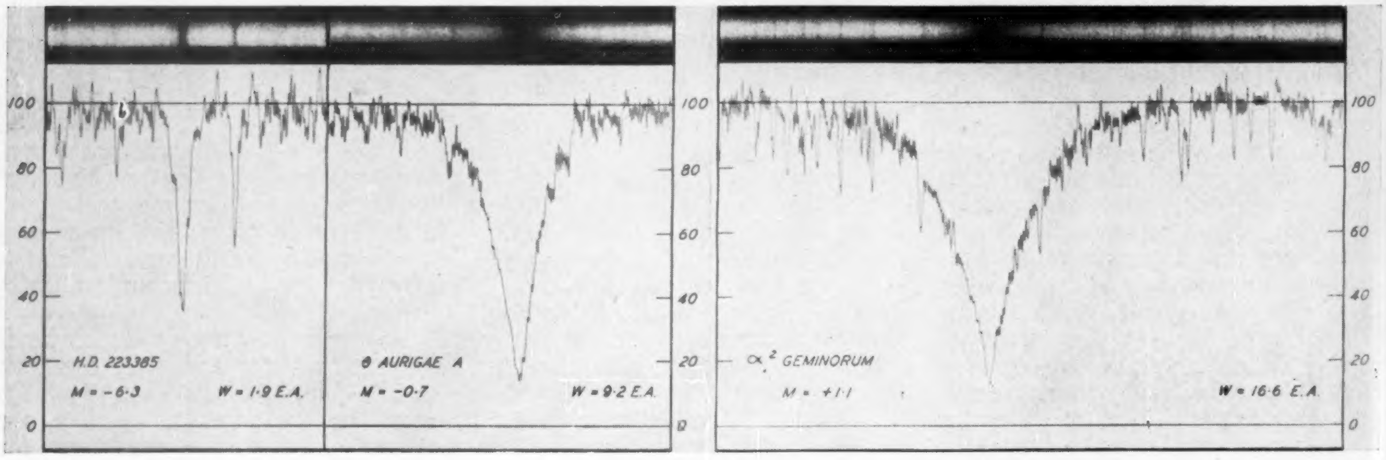
The belt is covered by 168 overlapping circular fields each 5°.3 in diameter. Exposures of five and two minutes on Eastman IIa-O emulsion are taken on each field. The survey includes stars of spectral class *B*5 and earlier, together with supergiant stars of later classes and objects of special interest between apparent photographic magnitudes 6.5 and 10.0. Already many new *B*-type stars and other unusual objects have been discovered.

At the National Astrophysical Observatory, Tonanzintla, Mexico, Dr. L. E. Erro is conducting a similar survey with the large Schmidt telescope there, equipped with an objective prism. A band six degrees wide centered on the galactic equator and extending over 290 degrees of galactic longitude is being covered, with exposure times that allow accurate classification of stars between the 8th and 12th magnitudes. The short exposures permit an overlap with the program at the Warner and Swasey Observatory, for the purpose of extending the system set up for the brighter stars to those of the 10th to 12th magnitudes. All but the southernmost 70 degrees of the Milky Way will be covered.

Supergiant Long-period Variables

AT LEAST a dozen bright variables observed in the direction of the Small Magellanic Cloud have been found actually to be members of that irregular galaxy, as the result of a study by Dr. Harlow Shapley and Virginia McKibben Nail, of Harvard College Observatory. The intrinsic luminosities are at least three magnitudes brighter than the average magnitude of the long-period variable stars in the Milky Way galaxy. Many of them have relatively small ranges of light change, but both in amplitude and period there are numerous similar stars in the galactic system.

To prove the membership of these variables in the Small Magellanic Cloud, variable star populations were studied down to the 16th magnitude in 14 variable star fields with galactic latitudes between 30° and 80°, and covering a total of somewhat over 1,000 square degrees of the sky. In these comparison regions, on the average was found one long-period variable star with maximum fainter than the 12th magnitude to each



Spectra and their intensity tracings to show the remarkable increase in hydrogen absorption from supergiants to dwarfs. HD 223385 (left) is a supergiant star of absolute magnitude −6.3; its hydrogen-gamma line has a width of 1.9 angstroms. Theta Aurigae A, of magnitude −0.7, has greater absorption, and that of one component of Castor (right) amounts to 16.6 angstroms. This is a normal main-sequence star of type A. Dominion Astrophysical Observatory photograph.

40 square degrees. But in an area of seven square degrees centered on the Small Magellanic Cloud there were at least 10 long-period variables of equal faintness at maximum. Thus, these stars were 50 times more numerous per unit area than elsewhere in high galactic latitudes.

A by-product of the investigation is a demonstration of the concentration of galactic long-period variables toward the plane of the Milky Way, for there is an almost complete absence of long-period variables with maxima fainter than photographic magnitude 14 more than 30 degrees from the galactic equator.

May 10th Solar Flare

A LARGE BRIGHT flare occurred on the sun between 3:03 and 5:20 (Eastern standard time) in the afternoon of May 10th, this year, and was photographed by the spectroheliograph at the McMath-Hulbert Observatory of the University of Michigan. Dr. Helen W. Dodson pointed out that the location and extent of the flare were strongly influenced by an underlying spot group, with the most intense portion of the flare directly over one of the principal spot components.

The spectroheliograms were made with a bandpass width of 0.36 angstrom centered on the hydrogen-alpha line. At maximum the flare had four times the intensity of the undisturbed hydrogen-alpha solar surface. On May 8th, another flare had been observed in the same spot group, its pattern and location very similar to those of its May 10th successor.

SUMMARY OF MAY 10, 1949 SOLAR-TERRESTRIAL PHENOMENA

PHENOMENON	TIME OF BEGINNING GCT	TIME OF MAXIMUM GCT	FIRST PHASE OF RECOVERY GCT	RECOVERY TO NORMAL GCT	REMARKS
H_α FLARE	2002	2011	2030	> 2220	PRELIMINARY ESTIMATES IMPORTANCE 3+
NOISE BURST 160 Mc	2000.4	2010.6	2017	2339	POWER INCREASES 286 TIMES
NOISE BURST 480 Mc	2001	2010.6	2012	2106	POWER INCREASES ≈ 1000 TIMES
SID h'-f	2003	2018	2030	> 2111	ABSORPTION TO 8 Mc
SID GLH	2003	2012	2028	2110	42 DB. DECREASE
SID W8XAL	2002	2010	2123	2200	45 DB. DECREASE
MAGNETIC CROCHET	2003	2015	2030	2045	24 GAMMAS IN H

The events of May 10th, compiled by Grote Reber, in Universal time. The Naval Observatory time for the flare's occurrence, 20:02, differs by only one minute from that determined at the McMath-Hulbert Observatory.

Striking effects of this outburst of solar energy were observed on the earth. At the National Bureau of Standards field station at Sterling, Va., Grote Reber and his associates recorded a tremendous burst of solar noise at 3:00.4 on microwave frequency 160 megacycles, and at 3:01 at 480 megacycles. The power increased 286 times in the first case, reaching its maximum at 3:10.6 p.m., when the increase at 480 megacycles had become about 1,000 times.

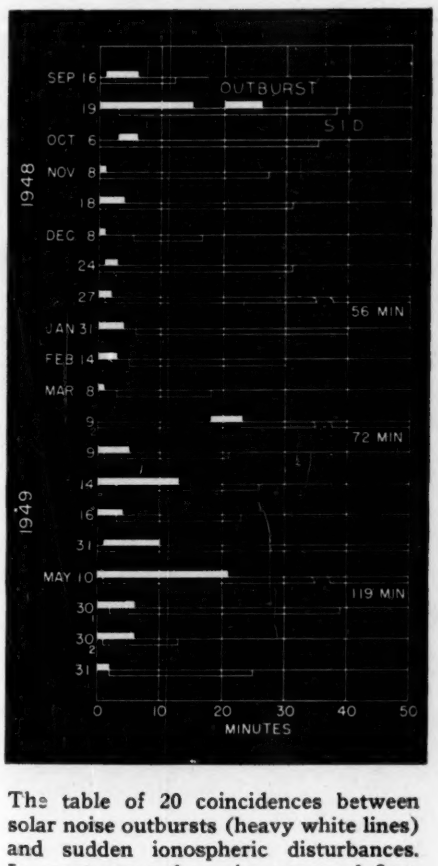
The radio-reflecting layers of the ionosphere were markedly affected also, for at precisely the time Dr. Dodson sets for the first appearance of the flare the reception at Sterling of short-wave station GLH (13.5 megacycles) in London, England, began a decrease that amounted to a change in signal strength of 42 decibels in only nine minutes.

Similarly, for station W8XAL (6.1 megacycles) in Mason, Ohio, reception at Sterling began to show added absorption in the transmission path that amounted to 45 decibels in only eight minutes, and took nearly two hours to recover.

Another check on the sudden ionospheric disturbance (SID) was provided by an 8-megacycle rapid-sequence transmitter at Sterling that sends up to the ionosphere its own signal and receives it back again. Precisely at 3:03 this returned signal (h′-f) began to decrease in intensity, with the maximum effect at 3:18.

Meanwhile, at the Department of Terrestrial Magnetism's Cheltenham, Md., geomagnetic station, a magnetic "crochet" was observed in the continuous records that are made there of the strength of the earth's magnetic field. Variations occurred both in the strength and direction of the field, which rose to a temporary maximum at 3:15 and returned to normal by 3:45. In addition, on May 12th, 34 hours and 22 minutes after the flare, an intense magnetic storm began.

In his paper, Mr. Reber presented a table to show that from September 16, 1948, to May 31, 1949, there were some 20 cases of coincidence between sudden radio outbursts and sudden ionospheric disturbances. Usually the radio outburst preceded the ionospheric changes by a few minutes, as is shown in the chart at the left.



The table of 20 coincidences between solar noise outbursts (heavy white lines) and sudden ionospheric disturbances. In most cases the noise occurred first. National Bureau of Standards chart.

Telescopic Meteors

THREE THOUSAND and more observations of meteors through telescopes have been reported to the American Meteor Society in the 20 years beginning in 1928, according to Dr. Charles P. Olivier, of Flower Observatory, president of the society. He presented some conclusions concerning this unique observing material in the symposium on meteoric astronomy.

The telescopic meteors have been seen by 81 persons, using instruments ranging in size from field glasses to a 27-inch refractor, but mostly from four to eight inches in aperture. Many members of the American Association of Variable Star Observers have made reports to Dr. Olivier, with Cyrus F. Fernald, of Wil-

ton, Me., having observed 503 telescopic meteors from 1941 to 1948.

A plot of the meteors for each magnitude reveals that their numbers do not *increase* below the 10th magnitude. The limiting magnitude for telescopic meteors with a given instrument is estimated to be two magnitudes brighter than for stars. In all the cases reported, not a single long-enduring train was seen.

P Cygni Stars

CERTAIN STARS of the early spectral types, mostly from *B*0 to *A*4, but including some *O*-type stars, have spectra that show a peculiar combination of bright emission and dark absorption components of the same spectral lines. The absorption is on the violet side of the emission, and the line profile may be one of four types, as described by Dr. C. S. Beals, Dominion Astronomer, who reported on an endeavor to collect into one paper significant data on all the known P Cygni stars.

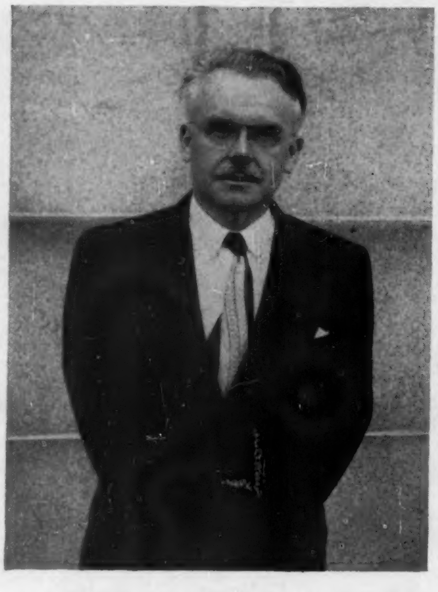
The list includes some 68 objects, ranging in absolute magnitude from −8.7 to +6.0, with an average value of −4.5. About one sixth of these stars are variable, or have been in the past. Their photoelectric temperatures range from 40,000° K. to 12,000° K.

Studies of the line profiles indicate accelerated outward motion of atoms for some stars and decelerated motion for others. The emission components are presumed to be produced by gaseous shells around the stars, and there is now evidence that the diameters of these shells are smaller than previously had been supposed.

Spectrum of R Cor Bor

THE BRIGHTEST MEMBER of a class of variable stars that remain at maximum light for much of the time is R Coronae Borealis. At irregular intervals they pass through minima of varying depth and duration. R Cor Bor itself began to fade from its maximum magnitude, about 6.0, late last November, and by the middle of February it had dropped to 14.0. It is still faint. During the descent to minimum, and for a short time after minimum was reached, the spectrum of the variable was observed as often as possible with the 82-inch telescope of the McDonald Observatory of the University of Texas. Dr. George H. Herbig, of Yerkes Observatory, described the spectral changes that were found.

At maximum light, the spectrum of R Cor Bor is matched most nearly by that of an *F*5 or *F*8 supergiant star, but the hydrogen lines are very weak and certain high-excitation lines of neutral carbon are fairly strong. It was these facts that led Berman to ascribe to the star a relatively low abundance of hydrogen and a relatively high abundance of carbon.



Dr. C. S. Beals, Dominion Astronomer and director of the Dominion Observatory at Ottawa, Canada. He is an authority on P Cygni stars.

As the variable faded, there were no spectral changes until magnitude 10.0, when weak, sharp emission cores appeared in the H and K lines of ionized calcium. At 10.8, these had become strong, quite hazy lines, and other emission lines appeared, while the normal absorption lines were weak or shallow as though veiled.

The next spectrogram could not be obtained until nine days later, because of bad weather. By that time, the star had fallen to magnitude 13.1 and it was necessary to reduce the dispersion from 75 to 150 angstroms per millimeter, because of the faintness of the star. The processes noted at 10.8 had continued, the spectrum appearing almost continuous, but with intense emission lines at H, K, and at 3888 angstroms. The remaining plates were taken as the variable faded to 14.0 and then recovered slightly. More emission lines appeared, about 80 of them being measured between wave lengths 3236 and 5893. The strongest were the D lines of sodium, followed by the three already mentioned. The remainder were due mainly to ionized scandium and ionized titanium, with no sign of hydrogen emission, which is in accordance with the weakness of hydrogen lines in the absorption spectrum.

Dr. Herbig suggests that the fact that only low temperatures are necessary to excite ionized scandium and titanium to shine accounts for their numerous lines, as opposed to ionized iron, which showed only one weak line. No marked changes in the strengths of the carbon lines or band were seen during the variations of R Cor Bor. The intense emission at wave length 3888 is unidentified, with an improbable possibility that it may be due to neutral helium.

These spectral peculiarities must be taken into consideration in any attempt to explain the strange behavior of such stars as R Coronae Borealis.

Comet Theory

A PICTURE of the nucleus of a comet as a conglomeration of "ices" of compounds that are gases at room temperature, but frozen solid at the extremely low temperatures of outer planetary space, was painted by Dr. Fred L. Whipple, of Harvard College Observatory, in a paper entitled, "Comets, Meteors, and the Interplanetary Complex," given as part of the symposium on meteoric astronomy.

As a comet of this nature moves in its eccentrically shaped orbit nearer and nearer to the sun the heat of the sun's radiation would cause the ices to evaporate and to produce the huge cloud of gas that we observe to be the coma or head of the comet. Possible compounds thus evaporated would be water (H_2O), ammonia (NH_3), methane (CH_4), carbon dioxide (CO_2) or carbon monoxide (CO), C_2N_2, and other materials volatile at room temperature.

In addition to these volatile compounds, however, the nucleus of the comet would contain some solid particles or hunks of matter, similar to those that form meteor swarms. It would be through an outer matrix of this meteoric material — forming a surface layer on the comet nucleus — that the evaporation would have to take place, and Dr. Whipple finds that because of a time lag in the transfer of heat into the interior of the comet nucleus, the principal emission of gases would take place in an unsymmetrical manner with reference to the nucleus as a whole.

Thus, for a comet rotating in a forward sense, that is, counterclockwise if its orbit around the sun were counterclockwise, the greatest emission of gases would lag somewhat behind the position on the nucleus directly toward the sun. Thus, the emission would be behind the nucleus, or backward, the reaction giving a forward motion or push to the comet and tending to increase the eccentricity of the orbit in this case. On the other hand, were the comet to rotate opposite to its orbital motion, the emission would be forward and the comet would have the eccentricity of its orbit reduced. This would explain the "resisting medium" that has been suggested by some theorists to account for the abnormal motions of comets.

For instance, Comet Encke, which has a period of 3.3 years, is gradually spiraling inward to the sun and its orbit becoming less eccentric. If the decelerating force component for retrograde

(Continued on page 320)

The third day of the convention was held at Mount Wilson Observatory, here photographed from the air. At the right is the dome of the 100-inch telescope, and to its left the 60-inch. At the extreme left edge is the horizontal Snow telescope, with the 60-foot and 150-foot towers nearby. The small dome left of center houses a small refractor.

WESTERN AMATEURS' CONFERENCE

BY CHARLES J. SCHOPKE AND CARL ANDERSON

Sacramento Valley Astronomical Society

SUPPOSE you were living in California, more particularly in California's capital city of Sacramento, some 400-odd miles from the world-famous Los Angeles, and the occasion to bridge this distance was the first convention of western amateur astronomers, where would you start reporting this gathering? Would you begin with the appeal for the holding of such a conference by Professor G. Bruce Blair, head of the astronomy department of the University of Nevada and of the Astronomical Society of Nevada, and the acceptance of that appeal by the Los Angeles Astronomical Society? Would you recount the big pre-convention task undertaken by the members of that group? Would you emphasize the theme or the chronology of the program?

In any event, the three-day convention was held on August 22-24, 1949, in the Bovard auditorium, University of Southern California. The first morning was devoted to the registration of delegates and to getting acquainted with fellow amateurs from far and near. When the roll closed, 197 delegates from 21 states with memberships in 23 astronomical societies had registered. The largest single delegation from outside of Los Angeles came from Sacramento — 18 members of our society attended. There were delegates from the East Coast and from the Canadian border to the Mexican border.

Considered almost inconceivable by Southern Californians, rain and thunder preceded the formal opening of the convention Monday afternoon. The rather large Bovard auditorium served to keep us comfortable in the prevailing warm weather. Professor Blair presided at this session for papers on general astronomical topics.

Professor G. Bruce Blair, of the University of Nevada, editor of "Astronomical Information Sheets."

Walter DePalma, president of the LAAS, delivered the address of welcome. He recommended the formation of a congress of western amateur societies during his discussion of promoting the work of amateur astronomers. His talk was enlivened by his entering into the oft-conjectured problem of life on Mars. In the realm of atomic forces, he wondered if man would duplicate the energies at play in Cepheid variables and in sunspots. He thought that the amateur astronomer might contribute something toward the solution of these questions.

Professor K. A. Ryerson, dean of the college of agriculture, University of California, delivered an appreciation of the late Russell W. Porter. He told much of Porter's life, of his limitless devotion to amateur and professional astronomy, and of his exploits as arctic explorer, scientist, musician, sculptor, and painter.

The tracing of the path of the October 14, 1948, meteor over the western states was described in a paper by Dr. J. Hugh Pruett, University of Oregon, and read by Dr. C. H. Cleminshaw, of the Griffith Observatory. The northwest regional director of the American Meteor Society finds it possible to work up fireball paths by correspondence rather than by traveling far and wide, provided he is willing to write repeated letters of instruction and to work hard

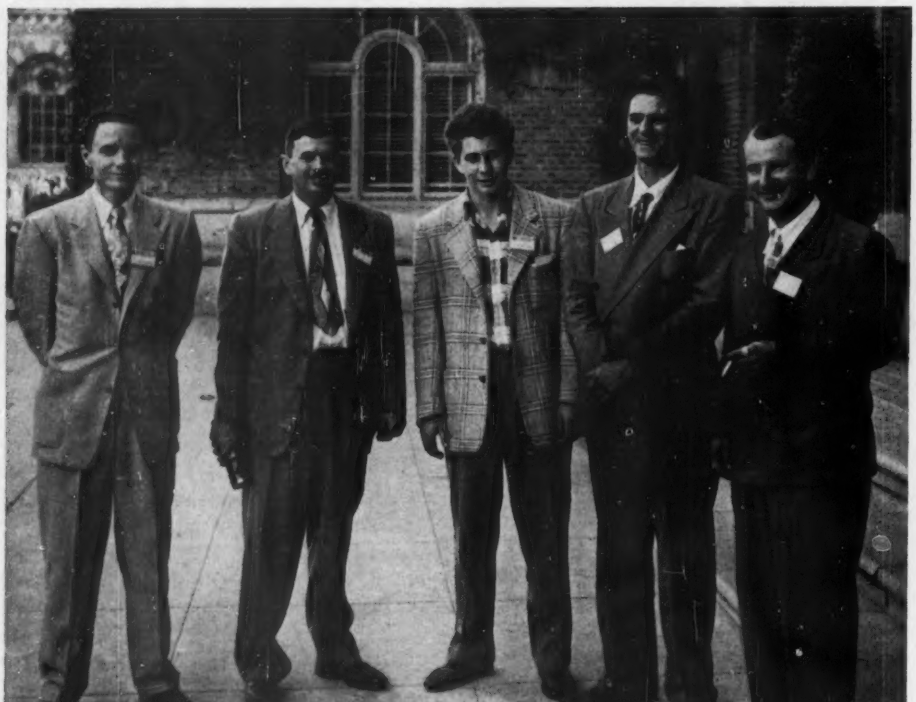
on the project. He sends out cheap clinometers and compasses for altitude and azimuth readings, and asks the co-operation of school principals and teachers in obtaining precise observations. He finds that most "estimated" altitudes are too high — for a 10° altitude 90 per cent of even good amateurs estimate as high as 20°.

A paper on "Light" was given by Mrs. Fayetta H. Philip, of the Sacramento Valley Astronomical Society.

Mrs. Helen S. Federer, then president of the Astronomical League, drew attention to the fact that the activities of amateur astronomers frequently transcend the bounds of local societies, and recommended the Astronomical League as a means for the co-ordination of such endeavors. She extended to the convention delegates an invitation to attend the national convention of the league which will be held next year at Wellesley, Mass. Charles A. Federer, Jr., illustrated a talk on the congress of the International Astronomical Union in Switzerland in 1948 with slides showing many of the outstanding astronomers in attendance.

The first western convention of amateur astronomers, at the University of Southern Ca

In his paper titled, "Amateur Astronomy in the Far West," Professor Blair described the march of the western amateur and of 13 astronomical societies. The listener could feel the speaker's presence in that parade by the personal familiarity he displayed with all the marchers. At the close of his survey of nearly 30 years, we could see among us the very men of whom he spoke. He posted a list of astronomical societies, beginning with the Eastbay Astronomical Society, founded in Oakland in 1923, and closing with the now forming Astronomical Society of Utah, at Salt Lake City. By city names, the others are: Los Angeles, 1925; San Diego (AA), 1930; Tacoma, 1931; Reno, 1936; Norwalk, 1936; Yakima, 1936; San Diego (ATM's), 1938; Portland (ATM's), 1940; Portland, 1941; Sacramento, 1945; Palo Alto, 1946.



Left to right: C. Rex Bohannon, convention publicity committee; George W. Bunton, program committee; Thomas A. Cragg, chairman, convention physical arrangements committee; Walter DePalma, president, LAAS; and Thomas R. Cave, Jr., chairman, convention program committee.

That evening, our objective was Griffith Observatory, where the delegates were given full run of this famous mecca of popular astronomy. It is three institutions under one roof: an observatory, a planetarium, and a hall of science. Situated atop a 1,000-foot peak in Griffith Park, it commands a view of the skies and of the Los Angeles metropolitan area.

Dr. Dinsmore Alter, director at Griffith, in his talk on "Co-operation Between Professional and Amateur," declared that the principal difference that he could see between the two kinds of astronomers was in the degree of enthusiasm displayed. He held that most astronomers of old were amateurs, and that in general the training of a professional had to be much broader than that of an amateur. He hoped for organization among western amateurs and that every year or two there would be a meeting that one would not want to miss.

Then Dr. C. H. Cleminshaw, associate director of Griffith Observatory, guided us on a "Trip to the Moon." It was not difficult to imagine oneself peering into the limitless distance, watching the earth exchange dimensions with the moon. When the lunar craters took on gigantic proportions, we were told that we would hover 1,000 miles above our satellite and make an attempt to land only sometime in the future. Looking back toward our earth, we saw that the markings on it were hazy because of its atmosphere.

In a talk on the optics of the Zeiss projection instrument, George W. Bunton, planetarium chief technician, pointed out the great loss to popular instruction in astronomy brought about by the de-

Southern California, Los Angeles, August 23, 1949. Photograph by D. J. Erickson.

struction of the Zeiss plant in the war. He described Griffith apparatus already built or in process to make possible imaginary voyages to the planets and even to the remote Milky Way nebulae and star clusters.

The morning session for papers on Tuesday was devoted to telescopes and accessories, with H. L. Freeman, secretary-treasurer of the LAAS, presiding. Samuel J. Smyth, of the Sacramento group, described "Building a Pull-off Telescope House." He summed up the advantages of his observatory, which slides out of the way on a track while the telescope is in use: the ease of handling, the complete ventilation while observing, the accommodation of large groups without steps or ladders, the economy of construction, as labor and materials need not cost over 50 dollars. Another Sacramento amateur, Harold Simmonds, described the satisfactory performance of a 16-inch tile grinding tool. He used 2½-inch hexagonal floor tiles. Mr. Freeman commented that the Los Angeles group now uses a ceramic tool — all one piece — grooved with a hacksaw blade as desired.

Howard D. Thomas, of Coulee Dam, Wash., spoke about "Stress-deformed Laps." By means of a long lever he can apply heavy pressure to the work and attain better control than by long, uncertain periods of hot or cold pressing. In a talk on eyepieces, Mr. Freeman described the common defects of Ramsden and Kellner oculars and discussed methods to reduce reflections, ghosts, light losses, and eyestrain. The advantages gained by a Barlow lens were explained, but the amateur was cautioned to make his purchase from a reliable source. This talk was followed by one on eyepiece lens manufacture by Mr. DePalma, in which he recommended that an amateur buy his eyepiece lenses unless he has the proper machinery to make them and expects to specialize in the field.

Also at this session, H. C. Schepler, Peninsula Astronomical Society, discussed a device developed at Stanford University to measure the transmission of light through air. The Sacramento College Observatory was described in a paper prepared by Leon Salanave, Sacramento Junior College, and delivered by C. A. Fogus. Richard W. Thompson, LAAS, outlined a method for aligning the polar axis of a telescope. Bruce Bowslaugh, LAAS member and technician, Applied Research Laboratories, Glendale, described the manufacturing processes in producing commercial diffraction gratings. While he told of gratings containing 36,000 lines per inch, he displayed a sample with 24,000 lines having an estimated value of $1,700.00. These results were achieved after the ruling machine had been moved to an underground vault outside of the city.

Professor Walter H. Haas, director of the Association of Lunar and Planetary Observers, presided at the afternoon session. He stated in his own paper that worthwhile observing could be done with a good 5-inch reflector or a 4-inch refractor. Some suggested projects which the amateur could undertake with credit to himself and with much assistance to the professional are: recording of transits of satellites across primary planets; determining rotation periods of planets, particularly Jupiter; and mapping lunar surface features.

Space does not permit detailed rendition of many of the excellent papers on the convention program. The entire proceedings of the conference were recorded and will be reproduced, including essential charts and slides, in bound form. The advance order price was $7.50, and it is suggested that those wishing further information communicate with the Hollywood Convention Reporting Company, 5410 Wilshire Blvd., Suite 606, Los Angeles, Calif.

David P. Barcroft, Madera, Calif., spoke on "Drifting of Lunar Formations During the Moon's Pre-hardening Period." Paul Roques, of the Griffith Observatory, discussed planetary photography. Mr. Schepler described the Emerson Astronomical Society of St. Louis,

A group of convention delegates: (left to right) Dr. Henry Power, Peninsula Astronomical Society, Palo Alto; H. J. Carruthers, Portland Astronomical Society and Portland ATM's; Arthur W. Orton, Peninsula Astronomical Society; and George W. Shuster, of Northridge, member of the LAAS.

Walter H. Haas, of the University of New Mexico, editor of "The Strolling Astronomer."

formed by a group of employees of the Emerson Electrical Company. Thomas A. Cragg, LAAS, spoke on "The Axis of Rotation of Venus," which paper was also presented at the Cleveland convention of the Astronomical League. Arthur W. Orton, president of the Peninsula Astronomical Society, gave a paper on photographing Comet 1948l. Thomas R. Cave, Jr., LAAS, listed some observing programs for amateurs. He classified amateurs into telescope makers, nature lovers, and serious observers. Charles J. Schopke, SVAS, in a paper entitled, "The Eyes of the World Are on Us," held that California particularly and the West generally had a favorable environment for the amateur astronomer because of the proximity to the world's largest telescopes. He advocated a closer union among western societies. Dr. Henry Power, Peninsula Astronomical Society, described equipment for recording lunar occultations. Mr. Bunton presented a paper for Clarence Friend, Escondido, Calif., on comet hunting, a process at which Mr. Friend is very adept. He recommended using a 5-inch short-focus refractor with an altazimuth mounting — plenty of patience is needed.

The convention banquet was held Tuesday evening in the Roger Young auditorium. President DePalma, presiding, gave an informal address, and then each person present introduced himself. It was evident that the representation at the convention was not just local or western.

Our final day was spent on Mt. Wilson, where many had their first views of the 100-inch telescope, the 60-inch reflector, and the two solar tower telescopes. Dr. Edison Pettit operated a monochromator attached to a 6-inch refractor, thus enabling us to view the solar prominences directly. In the feature lecture of the day Dr. Robert S. Richardson illustrated a talk on "Sunspot Cycles" with fine graphs. He showed a typical radiogram whose message was distorted by solar magnetic disturbances. Your reporter's memory went back to the days when he was learning to use a blank typewriter keyboard. The Japanese astronomer Kimura was credited with a remarkably accurate analysis and prediction of sunspot activity, although some modifications are required in his original work. Blake Mitchell, LAAS, gave a paper on mirror figuring.

A short business meeting concluded the formal program on Mt. Wilson, with the Sacramento and Oakland groups having extended invitations for holding the next convention in their respective cities. Professor Blair urged the immediate formation of an organization of individual amateurs, particularly to insure the financing of the next convention. The matter of organization was finally referred to a committee of five.

Following dinner at the Mt. Wilson Hotel, and under perfectly clear skies, star-party observers made use of the amateur-made telescopes set up for that purpose and as entries in the contest that was to follow. Judges for the contest were Professor Blair; George F. Joyner, Norwalk, Calif.; Dr. Power, and your reporter Schopke. It required great care to select the winners since every entry had much merit. The 34 instruments included five monoculars and binoculars, and all were trained on Jupiter. Your reporter saw Jupiter in many places for several days thereafter. One has seen a lot of the planet after looking through 34 telescopes at least twice each and in a number of cases three and four times. In the course of their work, the judges found the flashlights of photographers

H. L. Freeman, treasurer and business secretary of the Los Angeles Astronomical Society.

from *Time* and *Life* magazines did not help in trying to judge telescope performance critically. However, the unanimously voted awards were:

Best optics — Carl Helm, 908 Westholme Ave., Los Angeles. Best mounting and best accessories—George Schmid, 816½ 85th St., Los Angeles. Most unique instrument — Chalmers Myers, Box 157, Terminal Island.

The convention closed, and those of us who appraised it critically and analytically feel that the next convention host has a high standard to follow. The events of the program followed each other smoothly, one might say naturally. Every move that was made indicated careful planning and co-ordination of committee work. We, the guests, went home with the sense that we had attended a great convention.

In Focus

LARGE PLATE SCALE combined with high speed makes the 48-inch Schmidt telescope on Palomar Mountain an ideal instrument for photographing such extensive diffuse nebulae as that surrounding the cluster NGC 2244, near the star 12 Monocerotis, and pictured on our back cover this month. A study of this picture, in combination with one taken in red light, has been made by Dr. R. Minkowski, of Mount Wilson and Palomar Observatories. In red light, the wreathlike appearance of this Rosette nebula is even more noticeable than it is on photographs in blue light.

He points out that the nebula has an emission spectrum, and is surrounded by and probably embedded in obscuring material. This region of Monoceros is noted for the abundance of **O**-type stars, four of which may cause the nebula to shine. Two of them, at least, are important, and their distance is about 2,500 light-years. As the apparent diameter of the nebula is 80 minutes of arc, its linear diameter is about 55 light-years. The mass of the bright nebulosity is about 10,000 times the sun's.

In regions where the dark nebulosity is prominent, an abundance of dark spots each less than five seconds in diameter may be seen. As this is less than 4,000 astronomical units at the distance of the main nebula, they may be even smaller than the "globules" suggested by Dr. Bart J. Bok as being stars in formation from coalescing dark matter in a nebula (**Sky and Telescope,** VI, 5, page 8, March, 1947).

Amateur Astronomers

NEW YORK ACTIVITIES

The 23rd season of the Amateur Astronomers Association will open in New York City this month, with the telescope mirror making class beginning October 4th, sponsored by the AAA's Optical Division. Earle B. Brown, Walter Howland, Eugene Kada, Richard S. Luce, and Alex A. Singer are instructors. The telescope makers use the workshop in the basement of the Hayden Planetarium.

The regular lecture meetings, open to the public, will be held this year in the duplex hall of the School Service Building, American Museum of Natural History, entrance on 77th Street. The first lecture is on Wednesday, October 5th, when Dr. Paul S. Watson, of the Maryland Academy of Sciences, will speak on "Exploring the Universe." On November 2nd, Dr. B. W. Sitterly, of the American University, will discuss "Why Must We Live on the Earth?"

Five classes, open to AAA members, will get under way the week of October 10th. W. Wallace Benjamin conducts the course in elementary astronomy on Monday evenings; Sidney Scheuer and Samuel C. Silver give intermediate astronomy on Thursdays; Gonzalo Segura, Jr., advanced astronomy on Tuesdays. On the third Wednesday of each month informal discussions in the appreciation of astronomy are led by Edgar M. Paulton. The home study course, open to those who cannot attend classes at the museum, will be conducted by Aileen A. Pindar and Hazel Boyd; the fee of $5.00 for this course covers registration, textbook, and a series of lessons and assignments. Registration fees for the other courses are $2.00 for each, except the mirror-making classes, for which a charge of $35.00 is made to cover materials and instruction.

Full information about these and other activities of the New York amateur society may be hád from George V. Plachy, secretary, Amateur Astronomers Association, Hayden Planetarium, New York 24, N. Y.

PITTSBURGH STAR PARTY

More than 2,500 visitors attended a star party held on August 1st at Flagstaff Hill, Schenley Park, Pittsburgh. Despite competition from the Pirates-Dodgers baseball game and the civic light opera, both in the immediate vicinity, the party was a success. The Amateur Astronomers Association and the Pittsburgh **Sun-Telegraph** jointly sponsored this first event of its kind in this city. The committee in charge included Leo N. Schoenig, Charles H. LeRoy, and E. E. Lewis.

A public-address system was used by Arthur L. Draper, director of the Buhl Planetarium; Mr. LeRoy, who is president of the Astronomical League; and several other members of the society. When darkness fell, seven reels of sound motion pictures were shown. These films dealt with the earth, a trip through space, and the making of optical glass; all subjects of value in connection with the observing through the telescopes.

Almost 25 reflectors and refractors were strategically placed on the hillside to avoid crowding. Although the sky was thinly overcast, two large groups of spots were seen on the sun just before it set and Venus and Jupiter were well observed. The moon proved to be the most popular sight of the evening. On hand to explain some of the celestial sights to visitors individually were Dr. Nicholas E. Wagman, director of the Allegheny Observatory; Charles V. Starrett, of the Buhl Planetarium; and the operators of the telescopes. Observations were continued until midnight.

Plans are already being made for a series of similar parties at different locations here next year.

JAMES E. BRUGH, president
AAA of Pittsburgh

AAVSO MEETING

The 38th annual meeting of the American Association of Variable Star Observers will be held at Harvard College Observatory, Cambridge, Mass., on Friday and Saturday, October 14th and 15th. The first session will be at 8:00 p.m. Friday, when a lecture will be heard in the observatory library. The following morning the general and business session is to convene at 10:00 a.m. At 2:00 p.m. the group photograph will be taken, and at 2:15 there will be a session for papers.

Social highlights of the meeting are a tea given by Dr. and Mrs. Harlow Shapley at the residence at 4:00 p.m. Saturday, and the annual dinner at the Hotel Commander ($3.00 per plate), at which the AAVSO that evening will pay its respects to Leon Campbell, its retiring recorder.

Successor to Mr. Campbell as Pickering Memorial Astronomer is Mrs. Margaret W. Mayall, of the Harvard Observatory staff. She has recently completed compilation of the Cannon memorial volume of the Harvard **Annals**, containing positions, spectral classes, and Henry Draper numbers of 86,932 stars.

OPEN NIGHTS AT INDIANA

The astronomy department of Indiana University is conducting a series of open nights at the Goethe Link Observatory, Brooklyn, Ind. On October 9th the telescope will be used to observe Jupiter, and a lecture on the asteroids will be given by Robert La Fara. On October 30th the moon will be observed, and it will be the subject of a lecture by William H. Potter.

The observatory will be open on these nights from 7:00 to 9:00 p.m., with the lecture given at 7:30 and repeated at 8:30. Admission is free, but by ticket only, either procured at the door or by sending a self-addressed stamped envelope to Astronomy Department, Indiana University, Bloomington, Ind. State whether the ticket is desired for the first or the second lecture on the date requested.

THIS MONTH'S MEETINGS

Chicago, Ill.: Dr. C. M. Huffer, of Washburn Observatory, will speak on "Photoelectric Studies of Eclipsing Stars," at the meeting of the Burnham Astronomical Society, Tuesday, October 11th at 8:00 p.m., in the Chicago Academy of Sciences auditorium.

Columbus, Ohio: On Tuesday, October 25th, at Campbell Hall, Ohio State University, 8:00 p.m., there will be a lecture on "The Earth, Inside and Out," before the Columbus Astronomical Society. The meeting will be preceded by a half-hour instruction in basic astronomy.

Detroit, Mich.: Dr. Hazel M. Losh, University of Michigan Observatory, will discuss "Changes in the Astronomer's View of the Universe," at the meeting of the Detroit Astronomical Society in State Hall, Wayne University, on Sunday, October 9th, at 3:00 p.m.

Indianapolis, Ind.: At the October 2nd meeting of the Indiana Astronomical Society, at 2:15 p.m. in Cropsey Hall, Jack Forbes will lecture on "Who Named the Stars?"

Kalamazoo, Mich.: The Kalamazoo Amateur Astronomical Association will meet on October 8th, at 8 o'clock, in the home of Mr. and Mrs. Harry C. Fleming, 136 S. Prairie Ave., when Dr. Paul Rood will talk on "Tycho Brahe, the Astronomer."

Los Angeles, Calif.: "Galactic Nebulae" is the title of the lecture by Dr. R. Minkowski, of Mount Wilson and Palomar Observatories, at the October 11th meeting of the Los Angeles Astronomical Society, at 7:45 p.m. in the Griffith Observatory.

New York, N. Y.: See under "New York Activities" in the adjoining column.

Pittsburgh, Pa.: The Amateur Astronomers Association of Pittsburgh will meet on Friday, October 14th, at 8 o'clock, in the Buhl Planetarium. Michael Andrews will give an illustrated lecture of a trip out west entitled, "Into the Sunset."

Pontiac, Mich.: Dr. Helen W. Dodson, of the University of Michigan and Goucher College, will lecture at the meeting of the Pontiac Amateur Astronomers Association, October 16th, 3:00 p.m., at the Hall of Science, Cranbrook Institute. Her subject is to be "New Aspects of Solar Activity."

Sacramento, Calif.: On Monday, October 3rd, at 7:45 p.m., at the Little Theater, Sacramento Junior College, the Sacramento Valley Astronomical Society will hear Professor G. Bruce Blair, University of Nevada, speak on "What We Know About the Planets."

San Diego, Calif.: On Friday, October 7th, at 7:30 p.m., the San Diego Astronomical Society will hear reports of delegates to the convention in Los Angeles, August 22-24. Also, Dr. Clifford Smith, State College, will speak on "The Story Behind Palomar." The meeting is in Room 504, Gas and Electric Building.

Stamford, Conn.: On October 21st, the Stamford Amateur Astronomers will hear their secretary, William L. Dutton, demonstrate and explain the use of "Spectroscopy in Astronomy." The meeting is at the Stamford Museum at 8:00 p.m.

Washington, D. C.: The National Capital Astronomers meet in the Commerce Building auditorium on Saturday, October 1st, at 8:00 p.m. The speaker is Dr. R. C. Tousey, Naval Research Laboratory, and his subject is "Spectroscopy of the Sun from Rockets."

BOOKS AND THE SKY

OUR SUN

Donald H. Menzel. The Blakiston Company, Philadelphia, 1949. 326 pages. $4.50.

THIS IS perhaps the first astronomical treatise since the well-known work of Copernicus to have publication withheld for security reasons. In any case, the recent military censorship has caused the most vital subject to be the last to be treated in the Harvard Books on Astronomy. Dr. Menzel's skillful description of our own star and its effects on the earth brings the current series to an impressive climax. I shall not attempt a complete summary. It might even be sufficient to say that **Our Sun** is truly a book of marvels, some old and many new, that will be a revelation to the general reader and a useful guide to the amateur astronomer who would taste the excitement of solar research.

We may find amusement in the concepts of the Egyptian sun worshipers, but we note a commendable concern which primitive people had for their descendants, as shown by the great amount of labor expended in preparing enduring records. Our generation completely disregards posterity by consuming, in a mere pip on the screen of human evolution, the stores of coal and oil which have been produced by millions of years of sunshine.

The graphic "panoramic sunscape" is followed by a review of atomic structure and the principles of spectrum analysis. Less familiar to most will be the chapter which explains how relative abundances of the elements in the sun are determined. We are comforted in finding, at least in the atmosphere, mostly hydrogen.

The most intriguing aspects of the sun are the complex phenomena carried on quite apart from the routine service of providing us with light and heat. Most conspicuous are the sunspots, a particularly fruitful field for the amateur astronomer. In addition to witnessing and recording these puzzling storms, there is the possibility of glimpsing rare and significant happenings. Especially to be watched are the spots near the edge of the sun. Some have been reported to appear as depressions, but there is evidence that the penumbrae are elevated. Occasionally, one sees "veiled spots," hazy markings not confined to the usual spot zones of the sun. Much observing is needed. We know little of the true nature of the spots, the cause of their magnetism, the 11-year cycle and the associated migration of the zones of preference.

The turbulence of the sun becomes more apparent when observations are made in monochromatic light. The differences in appearance of the surface when photographed in the light of hydrogen and calcium atoms are due to varying sensitivity of these atoms to conditions of excitation, and also to the unequal widths of the spectral lines. Most spectacular are the prominences, whose motions and behavior are extremely perplexing. Thanks to the coronagraph, it is now possible to keep a continuous record of this upper region of the sun's atmosphere, with the anomalous temperature of a million degrees. It is greatly to be hoped that interference filters will soon be made available to amateur observers.

One of the most distressing things about the atomic bomb is having to hear about it constantly. I was glad to see this matter reduced to a single page, in the chapter explaining the source of the sun's energy. It might have been worthwhile to explain why the stars obtain energy by processes at the low end of the periodic table, whereas men release atomic energy by fission of the heaviest elements. There is an excellent chapter on solar eclipses, containing a table of eclipses from 1900 to 2000 A.D. The concluding chapter deals with such practical matters as utilizing solar heat for homes, the effects of the sun on radio, the aurora, weather, and (possibly) the stock market, the last being only of academic interest to the poor astronomer.

The book is filled with remarkable photographs and lucid diagrams. This reviewer has noticed but two small errors. On page 156 it is said that one second of arc on the sun's apparent disk corresponds to about 800 miles on the solar surface. This was perhaps intended as kilometers rather than miles. The height of the prominence shown in Fig. 115 is considerably more than 25,000 miles.

Both Menzel and Copernicus are to be congratulated for their books on the sun!

W. A. CALDER
Agnes Scott College

FROM EUCLID TO EDDINGTON

Sir Edmund Whittaker. Cambridge University Press, New York, 1949. 212 pages. $4.00.

THE NOTED ENGLISH mathematician, Sir Edmund Whittaker, presents in this book a readable series of essays tracing the development of natural philosophy from Euclid to Eddington. The work is based on the Tarner lectures of 1947. He aims at giving neither a comprehensive summary of present-day physics nor a chronological account of particular scientific discoveries; rather, he traces the evolution of concepts and principles.

The book is divided into five parts: Space, Time, and Movement; The Concepts of Classical Physics; The Concepts of General Relativity; The Concepts of Quantum Mechanics; The Eddingtonian Universe. The individual essays cut across many fields of learning: mathematics, astronomy, physics, philosophy, and others.

This stimulating study in the history of ideas should prove of interest to a wide audience. It should be especially useful to students of the history of thought or philosophy, and to those taking general education courses dealing with the physical sciences.

RALPH S. BATES
Findlay College

ATLAS PHOTOMETRIQUE DES CONSTELLATIONS

A. Brun. Published by the author, Le Breuil, Allier, France, 1949. 2,200 francs, including postage to United States (approx. $7.25).

FIFTY-FIVE charts, each in area about 9½ by 12½ inches, make up this photometric atlas that includes stars to magnitude 7.5 and as far south as −30° declination. The co-ordinates are for the epoch 1900. The chief feature of the charts is that every star has its magnitude shown, to hundredths from the Revised Harvard Photometry for stars brighter than 6.5, and to tenths from the Harvard Durchmusterung for fainter stars. The Flamsteed and Bayer designations for all stars are also given.

Monsieur Brun points out that the atlas was originally compiled in 1910 for the observation of variable stars and meteors, and its use ever since has been for naked-eye and binocular observations. All the "A" maps supplied by the French association of variable star observers have been taken from this atlas. The scale is one centimeter to one degree.

Constellation boundaries, double stars, clusters, nebulae, and galaxies are also included, and all variable stars attaining at maximum a magnitude of 7.5, or brighter, according to Schneller's most recent catalogue. Both maximum and minimum magnitudes are shown. The symbols for galaxies indicate their types, and this ease of symbolism applies also to nebulae and clusters.

The atlas may be ordered directly from the author at the address above shown, payment best made by international money order. Each atlas is shipped in a cardboard tube. On orders of 10 or more to one address, shipped in a wooden box, M. Brun offers a discount of 50 cents each. The Atlas has an introduction and key in English, and American observers should therefore find no difficulty in using it.

C. A. F.

NEW BOOKS RECEIVED

ATOMS IN ACTION, *George Russell Harrison*, 1949, *Morrow*. 406 pages. $5.00.

The third edition of a book originally published in 1939 and now completely revised and expanded to include the latest discoveries in the world of creative physics.

THE HISTORY OF NATURE, *C. F. von Weizsaecker*, 1949, *University of Chicago Press*. 191 pages. $3.00.

A translation from the German, by Fred D. Wieck, of a book on science and philosophy by a scientist famed for his theories concerning the origin of the solar system and other celestial systems.

STAR NAMES, *Mouser* and *Forbes*, 1949, published by the authors. 38 pages and bibliography. $1.25.

A mimeographed list of over 2,000 star names arranged alphabetically and cross-referenced, compiled by two members of the Indiana Astronomical Society. Orders may be sent to Robert W. Mouser, 4526 Washington Blvd., Indianapolis 5, Ind.

THE CONQUEST OF SPACE, *Willy Ley*, 1949, *Viking*. 160 pages. $3.95.

This "preview" of the future is illustrated with paintings by Chesley Bonestell, some in color and others black-and-white.

RESEARCH AND DEVELOPMENT IN APPLIED OPTICS AND OPTICAL GLASS AT THE NATIONAL BUREAU OF STANDARDS, *Gardner* and *Hahner*, 1949, Superintendent of Documents, Washington, D. C. 20 pages. 15 cents.

This is a general account of the research and development in technological optics that has been completed at the National Bureau of Standards. Included are a comprehensive study of the relation between chemical composition and index of refraction of optical glass; a study of the relation between annealing temperature and index; and a bibliography of 195 bureau publications pertaining to optical glass and optical instruments.

SKYSHOOTING, *Mayall* and *Mayall*, 1949, *Ronald Press*. 174 pages. $3.75.

This book is subtitled, "Hunting the Stars With Your Camera," and is a volume of the Humanizing Science Series.

Planetarium Notes

BALTIMORE: ***Davis Planetarium.*** **Maryland Academy of Sciences, Enoch Pratt Library Building, 400 Cathedral St., Baltimore 1, Md., Mulberry 2370.**

SCHEDULE: 4 p.m. Monday, Wednesday, and Friday; Thursday evenings, 7:45, 8:30, 9:30 p.m. Admission free. Spitz projector. Director, Paul S. Watson.

BUFFALO: ***Buffalo Museum of Science Planetarium.*** **Humboldt Parkway, Buffalo, N. Y., GR-4100.**

SCHEDULE: Sundays, 2:00 to 5:30 p.m. Admission free. Spitz projector. For special lectures address Elsworth Jaeger, director of education.

CHAPEL HILL: ***Morehead Planetarium,*** **University of North Carolina, Chapel Hill, N.C.**

SCHEDULE: Daily at 8:30 p.m.; Saturday and Sunday at 3:00 p.m. Zeiss projector. Director, Roy K. Marshall.

CHICAGO: ***Adler Planetarium.*** **900 E. Achsah Bond Drive, Chicago 5, Ill. Wabash 1428.**

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m. Zeiss projector. Director, Wagner Schlesinger.

LOS ANGELES: ***Griffith Observatory and Planetarium.*** **Griffith Park, P. O. Box 9787, Los Feliz Station, Los Angeles 27, Calif., Olympia 1191.**

SCHEDULE: Wednesday and Thursday at 8:30 p.m.; Friday, Saturday, and Sunday at 3 and 8:30 p.m.; extra show on Sunday at 4:15 p.m. Zeiss projector. Director, Dinsmore Alter.

NEW YORK CITY: ***Hayden Planetarium.*** **81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500.**

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.; Wednesdays and Fridays, 11 a.m., for school groups. Zeiss projector. Curator, Gordon A. Atwater.

PHILADELPHIA: ***Fels Planetarium.*** **Franklin Institute, 20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Locust 4-3600.**

SCHEDULE: Tuesdays through Sundays, 3 p.m.; Saturdays, 11 a.m.; Saturdays, Sundays, and holidays, 2 p.m.; Wednesdays, Fridays, and Saturdays, 8:30 p.m. Zeiss projector. Director, I. M. Levitt.

PITTSBURGH: ***Buhl Planetarium and Institute of Popular Science.*** **Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300.**

SCHEDULE: Mondays through Saturdays, 2:15 and 8:30 p.m.; Sundays and holidays, 2:15, 3:15 and 8:30 p.m. Zeiss projector. Director, Arthur L. Draper.

SPRINGFIELD, MASS.: *Seymour Planetarium.* Museum of Natural History, Springfield 5, Mass.

SCHEDULE: Tuesdays, Thursdays, and Saturdays at 3 p.m.; Tuesday evenings at 8 p.m.; special star stories for children on Saturdays at 2 p.m. Admission free. Korkosz projector. Director, Frank D. Korkosz.

STAMFORD: ***Stamford Museum Planetarium.*** **Courtland Park, Stamford, Conn.**

SCHEDULE: Supplied on request. Admission free. Spitz projector. Director, Ernest T. Ludhe.

GLEANINGS FOR ATM's

A Planetary Telescope

A GREAT DEAL of interest is being shown of late in planetary observations. Recent articles have described several instruments especially suited for planetary work, although I have seen none mentioned like one I constructed some time ago. Made of simple parts, it performed excellently on the planets, and might readily serve for an inexpensive first telescope of this type.

Telescopes of long focal ratio are most suitable for planetary observations, because high magnification may be achieved without requiring very short eyepieces, and advantage may be taken of the relative freedom from aberrations inherent with the long focal ratios. It must be remembered, however, that aberrations are not necessarily completely absent even at very long focal ratios, especially in refractors, where even at f/30 and f/40 aberrations may affect definition considerably.

The main objective of my instrument was a good achromat of 2" aperture, f/15, giving a focal length of 30". Behind this, carefully centered on the optical axis, was placed an achromatic Barlow lens of 4" or 5" negative focal length, situated at such a distance from the objective as to extend the focal point back to 96". The focal ratio became f/48, but the effective focal length was 666", as the combination gave a 6" image of the sun. By coincidence, this was the same as the prime focal length of the 200-inch telescope on Palomar Mountain.

Since regular eyepieces are out of the question for such an arrangement, I used instead a good quality reading glass, a biconvex lens about 4" in diameter with a 6" focal length. This was placed at the proper distance back of focus, with the eye at the point of conjugate focus. The telescope had a power of 111, with a field of view 4" in diameter. Since it is hard for the observer to steady his eye at the right point, a focusing peephole was used, attached to the end of the telescope tube, with the eye lens well inside.

This instrument may be made in any size or length, but the ratios must be fairly closely adhered to. The eye lens may be made interchangeable, for various powers, but still in keeping with the rest of the optical train. The planets are viewed with delight. Their apparent size is the same as with ordinary instruments of like power, but the freedom from aberration allows the observer to pick out the finer details in their structure. The sky is darker, and the greater field easy on the eye.

Using this as a terrestrial instrument on a clear morning before the sun's rays caused atmospheric disturbances, I have looked at sparrows perched on a fence four miles away and have plainly seen the color of their eyes, as well as each individual "quilling" of the feathers. Also, under similar conditions, the little winged nuts reposing in their respective cones on pine trees have been observed clearly at considerable distances. Such fine definition is hard to imagine without having observed it oneself.

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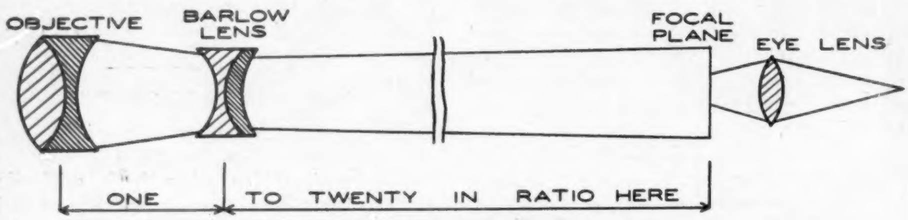
ED. NOTE. The fundamental calculations for the type of telescope Mr. Parmenter describes are: Let the objective focal length be $\mathbf{f}_1$; let the Barlow focal



A schematic diagram of B. C. Parmenter's planetary telescope, in which he used a Barlow lens rather close behind the objective, and a large eye lens.

length be f_2 (considered negative); let the separation of the two lenses be **d**.

Then, for the back focus (Barlow lens to focal plane):

$$BF = \frac{f_2\,(f_1 - d)}{f_1 + f_2 - d},$$

and for the equivalent focal length:

$$EFL = \frac{f_1\, f_2}{f_1 + f_2 - d}.$$

A TURRET EYEPIECE HOLDER

ON MY 6-INCH Newtonian telescope I have attached a simple eyepiece holder which has worked well and might be developed further, eliminating the need of rather expensive rack-and-pinion or helical slide adjustments.

It consists essentially of a small block which slides longitudinally on the outside of the telescope tube between two guides. From this block is suspended the prism holder, by some single-support method [a circular spider would do]. Focusing is accomplished by sliding this block. On top of the block is pivoted another block, circular or rectangular in shape, and with holes containing two or more eyepieces.

The focal planes of these eyepieces have all to be set at the same level, so that refocusing is not necessary when changing from one eyepiece to another. There should be as little clearance as possible (or a flexible rubber bushing) between the eyepiece holder and the opening into the telescope, to avoid stray light.

I have found the rotating battery better than a sliding one, but with machined metal the preference would disappear.

My particular observing goal has been to see the entire Messier series of nebulae and clusters. In his desire to catalogue comet-like objects, I wonder why Messier included such unmistakable star clusters as M23 and M44? And why did he include such very faint and small nebulae as M95 and M96 in Leo, while leaving out some others that are bright?

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A COMBINED LAP

IN THE January, 1949, issue of **Sky and Telescope,** two articles concerning tile tools and paper laps were published in the Gleanings department. I have had occasion to employ paper laps successfully twice within the last few years. Shortage of rouge and good-quality pitch just after the war compelled me to try my luck with paper, and the results were much better than I had expected.

On the continent, chiefly with the French ATM's, polishing on paper is a frequent practice. My first job was a 3.5-inch f/10, my second a 4-inch f/12. Polishing and figuring required 22 hours of work for both and was pronounced "very good" by a person most competent to judge.

Ellison's two main objections to the laps are that they have no yielding surface to embed the particles of grit, and that with the addition of the lap to the tool the

curves of tool and mirror are no longer coincident, thus resulting in turned-down edge and the like.

Concerning the first point, I employed rather thick drawing paper (as generally used for pencil sketches) and have never experienced a more "gemlike" finish. Polishing progressed quickly and without mishap; sleeks did not appear. As for the second point, I first provided the tool with a regular lap of unchanneled contaminated pitch and pasted thereon the paper polisher. Before commencing the work, the mirror was warmed slightly and the combined lap "warm-pressed" and then left to cool again. During polishing, repetition of this warm-pressing insured perfect contact of mirror and lap at all times. The combined lap operated very well and behaved just like the familiar pitch lap. Thinner paper improves its "flowing" qualities.

To me, this combined paper-pitch lap is simple and clean. There are no pitch chippings, no watery rouge mess. Laps may be renewed simply by scrubbing off the old paper polisher and gluing on a new one. Use ordinary model-building glue, employing a thin even coating. Brushing the outside (working) surface of the polisher with a stiff brush produces a velvety tool.

I would appreciate hearing from others who may try this method.

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SHORT-FOCUS REFRACTORS

May I endorse the high opinion that L. S. Copeland, of Santa Barbara, Calif., expresses on page 228 of his article in the July issue, regarding short-focus refractors of about four inches aperture. I have a 4-inch of 32 inches focal length, made by Keuffel and Esser for the first World War, which I have completely renovated for astronomical work. During the 10 years I have used this, I have made thousands of observations with it upon variable stars and the sun. It is also extremely good on the Milky Way, the nebula in Andromeda, and the star cluster in Hercules. Its only weakness is in planetary work. It is easily portable and is my favorite instrument.

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MEMORIAL TO PONTIAC AMATEUR ASTRONOMER

The Pontiac Amateur Astronomers Association has established a fund in memory of William Bogrand, a member of the society who died at the end of July at the age of 76. A veteran telescope maker, he was working on his 15th instrument, a 12½-inch reflector. It is proposed to use the fund to finish this instrument and to mount it in an observatory that society members will build.

GLEANINGS is always ready to receive reports and pictures of amateur instruments and devices, and is open for comment, contributions, and questions from its readers.

OBSERVER'S PAGE

Universal time is used unless otherwise noted.

Observations with a Small Reflector

MANY AMATEURS do not realize how much can be seen with a modest telescope. For my own interest, and as a guide to other amateur astronomers, I have compiled a small list of some of the celestial sights observed with my $3\frac{1}{2}$-inch Skyscope reflector. The observations were made in my garden during 1948-49, here at my home in Bayside where seeing conditions may be termed "moderately good."

Double and Multiple Stars

Mizar (ζ Ursae Majoris), readily separated with a 60-power eyepiece. Alcor and an 8th-magnitude star are also visible in the field. [Mizar's components are of magnitudes 2.4 and 4, their separation 14 seconds of arc, at position angle 150°.]

Albireo (β Cygni) is readily separated with the 60-power eyepiece. Its components are gold and blue. [Mags. 3.2 and 5.4, 34".6 at 55°.]

Castor (α Geminorum) cannot be separated with 60x, but yields readily to 100x. [Mags. 2.0 and 2.9, 4".5 at 200°.]

Cor Caroli (α Canum Venaticorum) is easily separated with 60x. [Mags. 2.9 and 5.4, 19".7 at 228°.]

Schedir (α Cassiopeiae). Its 9th-magnitude companion is widely separated at 60x as it is 62 seconds of arc from its primary, at 280°.

Rho Herculis (ρ) is "tough," but can be separated with 100x; better result with 150x if the sky is really clear. [Mags. 4.5 and 5.5, 4".0 at 314°.]

Epsilon Lyrae (ϵ). The quadruple components can be separated with 100x if the atmosphere is free from mist; better result with 150x. [One pair is of mags. 5.1 and 6.0, 3".1 at 0°; the other 5.1 and 5.4, 2".5 at 115°.]

Sigma Orionis (σ). Appears as three stars with 60x, although it is really a quintuple system.

Gamma Leonis (γ) appears as a single point of light with 60x; yields to 100x. [Mags. 2.6 and 3.8, 3".9 at 120°.]

61 Cygni. The famous double whose distance was first to be measured is easily separated with 60x. [Mags. 5.6 and 6.3, 25".0 at 140°.]

Clusters and Nebulae

Double Cluster in Perseus. Good but incomplete resolution with 60x.

M13 (Hercules globular) appears with 60x as a circular whitish spot between two stars of about the 8th magnitude; no resolution with 100x, but in good sky it shows signs of resolvability with 150x.

M31 (Great Nebula in Andromeda) appears as a hazy oval spot with 60x; with 150x there is a considerable increase in its apparent size.

M35 (open cluster in Gemini). Good though incomplete resolution with 60x; stars too far apart for favorable result with higher power.

M41 (open cluster in Canis Major). Good resolution with 60x.

M42 (Great Nebula in Orion). The Trapezium stars are clearly visible with 60x. The nebula appears as an irregular bluish haze.

M44 (Beehive or Praesepe, in Cancer). A blaze of stars covering the whole field, best with 60x.

M45 (Pleiades in Taurus). At 60x about 60 stars appear in the field dominated by the quadruple star Alcyone (η Tauri).

M57 (Ring nebula in Lyra). It is visible if the night is favorable, but difficult to detect. Details cannot be seen.

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A FAVORABLE ECLIPSE OF THE MOON

THE HUNTER'S MOON, October 6-7, will be in total eclipse this year. This spectacle of nature may be generally observed from the United States and Europe, occurring in the evening hours on this side of the Atlantic Ocean. Last month's chart gives the circumstances of the eclipse, but the following timetable may be useful, all for the night of October 6th to 7th.

Event	EST	CST	PST
Moon enters penumbra	6:50	5:50	3:50
Moon enters umbra	8:05	7:05	5:05
Total eclipse begins	9:20	8:20	6:20
Middle of eclipse	9:56	8:56	6:56
Total eclipse ends	10:33	9:33	7:33
Moon leaves umbra	11:48	10:48	8:48
Moon leaves penumbra	1:03	12:03	10:03

All times are p.m. on October 6th, except 1:03 and 12:03, which are a.m. on October 7th.

Several notable differences between this and the April eclipse are apparent. The moon has a smaller diameter (29' 24") as it is at apogee, farthest from the earth. The umbra is somewhat smaller at that distance, about 5,650 miles (77' of arc in the sky), including the earth's atmosphere. The penumbra is larger and the moon's motion slower at apogee, two effects which combine to give an eclipse duration of six hours 13 minutes, compared to five hours and 19 minutes in April.

Entering of the umbra should be noted at the limb near the crater Aristarchus, brightest spot on the moon. Last contact occurs about 6° south of Mare Crisium, on the west limb. The position angle of the moon's axis is about 21° west of the north point.

During totality, occultations of faint stars may be seen in telescopes. Various colors and the visibility of surface features may be noted at progressive stages of the eclipse. One program for possessors of binoculars is obtaining the magnitude of the eclipsed moon. Look through them backwards (objectives eyeward) and compare the lunar image to those of nearby stars. Photography may be attempted, using red-sensitive film (panchromatic). Excellent results have been obtained with Kodachrome or Ansco color.

E. O.

THE ARISTARCHUS GLEAM

During the eclipse of April 12, 1949, at 8:58 p.m. PST, while the lunar crater Aristarchus was still completely in the umbra, I observed that it was gleaming white and starlike, in contrast with the orange-red color of the umbra. Up to the present I have found only one other observer who saw the gleam, but made a photograph just too late to record it, for Aristarchus had already entered the penumbra.

I am wondering whether the phenomenon will be repeated on October 6th. The conditions are not so favorable as the moon will then pass south of the center of the umbra instead of north. This means that by the time any mountains that might reflect light to Aristarchus become illuminated, the sunlight will have covered a considerable part of the moon's disk, and the glare may make the Aristarchus gleam invisible. However, it should be worth trying to observe it. Any mountain within the small illuminated

crescent that might have reflected the light to Aristarchus must have been a very substantial peak.

On October 6th, if careful observations are made to determine just when the Aristarchus gleam first appears, that will give us a line on the moon's surface, the edge of the penumbra, on which the reflecting mountain must be located. That line will intersect the corresponding line for the eclipse of April 12th. I hope as many observers as possible will be on the alert with their telescopes to note the earliest appearance of the gleam after the end of totality at 3:33.2 UT. In roughly the next 10 minutes it should be visible, but shortly thereafter Aristarchus itself will once more be in the penumbra and the gleam probably not observable.

If in this 10-minute period series of photographs in rapid succession can be made, it should be possible to record the gleam and determine whether it appears suddenly or gradually. Exposures should be sufficient to observe a star of the 6th or 7th magnitude. This will overexpose greatly the sunlit portion of the moon, and backed film or plates should be used to avoid halation. A color-blind film, insensitive to red light (not panchromatic), such as Eastman 40 or 50, will give better contrast between the white gleam and the red background. Some exposures on Kodachrome might show the contrast directly.

I shall be pleased to hear from any amateurs who attempt observations as above outlined, whether or not their results confirm the Aristarchus gleam.

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FIREBALL NOTES

Dr. Charles P. Olivier, director of the American Meteor Society, Flower Observatory, Upper Darby, Pa., has requested reports on a huge, moon-bright fireball that flashed over Tennessee, Alabama, and Kentucky, at about 8:30 p.m. CST, September 1st. It was believed to have been seen by thousands of persons. Careful estimates of the altitudes and azimuths of beginning and end points are needed, together with the observer's exact geographical location.

Edward A. Halbach, director of the Milwaukee Astronomical Society Observatory, calls attention to a series of northward-traveling fireballs reported in the upper Middle West between July 22nd and August 9th. The first of these was described last month (page 292).

MOON PHASES AND DISTANCE

Full moon	October 7, 2:52
Last quarter	October 15, 4:06
New moon	October 21, 21:23
First quarter	October 28, 17:04
Full moon	November 5, 21:09

	October	Distance	Diameter
Apogee	7^d 17^h	252,500 miles	29′ 25″
Perigee	21^d 15^h	222,000 miles	33′ 27″

MINIMA OF ALGOL

October 2, 1:53; 4, 22:42; 7, 19:31; 10, 16:19; 13, 13:08; 16, 9:57; 19, 6:46; 22, 3:34; 25, 0:23; 27, 21:12; 30, 18:01. November 2, 14:50; 5, 11:39; 8, 8:27.

JUPITER'S SATELLITES

October 1, 40123; 3:27 I Tr, 4:44 I Sh, 5:43 I TrE, 7:00 I ShE, 23:42 II Tr. **2,** 430; 0:41 I Oc, 1:14 III TrE, 2:12 II Sh, 2:27 II TrE, 2:52 III Sh, 4:15 I EcR, 4:58 II ShE, 6:27 III ShE. **3,** 43210; 0:12 I TrE, 1:29 I ShE, 23:45 II EcR. **4,** 43021. **5,** 43102. **6,** 42013. **7,** 12403; 7:31 II Oc, 23:35 IV Ec. **8,** 0123; 4:04 IV EcR, 5:21 I Tr, 6:39 I Sh, 7:38 I TrE. **9,** 10324; 1:37 III Tr, 2:14 II Tr, 2:35 I Oc, 4:48 II Sh, 4:59 II TrE, 5:08 III TrE, 6:10 I EcR, 6:54 III Sh, 7:35 II ShE, 23:50 I Tr. **10,** 3204; 1:08 I Sh, 2:06 I TrE, 3:25 I ShE.

October 11, 3014; 0:39 I EcR, 2:24 II EcR. **12,** 31024. **13,** 20314; 0:34 III EcR. **14,** 21034. **15,** 01243; 23:50 IV TrE. **16,** 14023; 4:29 I Oc, 4:48 II Tr, 5:35 III Tr. **17,** 42301; 1:45 I Tr, 3:04 I Sh, 4:02 I TrE, 5:21 I ShE, 22:58 I Oc, 23:28 II Oc. **18,** 430; 2:34 I EcR, 5:03 II EcR, 23:50 I ShE. **19,** 43102; 23:11 III OcR, 23:28 II ShE. **20,** 4201; 0:57 III Ec, 4:35 III EcR.

October 21, 42103. **22,** 40123. **23,** 41023; 6:25 I Oc. **24,** 23401; 3:41 I Tr, 5:00 I Sh, 5:34 IV Oc, 5:58 I TrE. **25,** 3204; 0:54 I Oc, 2:08 II Oc, 4:29 I EcR, 23:29 I Sh. **26,** 31024; 0:27 I TrE, 1:46 I ShE, 22:58 I EcR, 23:16 II Sh, 23:30 II TrE, 23:41 III Oc. **27,** 2014; 2:04 II ShE, 3:16 III OcR, 4:58 III Ec. **28,** 21034. **29,** 02134. **30,** 10234; 22:32 III ShE. **31,** 23014; 5:39 I Tr.

November 1, 32104; 2:51 I Oc, 4:50 II Oc. **2,** 34012; 0:08 I Tr, 1:24 I Sh, 2:24 IV Sh, 2:25 I TrE, 3:41 I ShE, 23:23 II Tr. **3,** 430; 0:53 I EcR, 1:52 II Sh, 2:09 II TrE, 3:50 III Oc, 4:40 II ShE. **4,** 42103; 23:39 II EcR. **5,** 40213. **6,** 41023; 22:58 III Sh. **7,** 42301; 2:34 III ShE. **8,** 43210; 4:48 I Oc. **9,** 34012; 2:06 I Tr, 3:20 I Sh, 4:23 I TrE, 5:37 I ShE, 23:18 I Oc. **10,** 3402; 0:28 IV Oc, 2:04 II Tr, 2:48 I EcR, 4:28 II Sh, 4:47 IV OcR, 4:50 II TrE, 22:53 I TrE.

In the accompanying data, taken from the American Ephemeris and Nautical Almanac, following each date (in bold-face type) are given the telescopic satellite positions west (left) or east (right) of Jupiter (which is designated 0) at 1:15 UT in October, and at 0:00 in November.

Then are given the Universal time, the satellite (Roman number), and the phenomenon. Tr and TrE are the beginning and ending, respectively, of a satellite transit; Sh and ShE, same for the shadow; Ec and EcR are eclipse disappearance and reappearance, respectively; Oc and OcR, same for occultation.

AMERICAN ASTRONOMERS REPORT

(Continued from page 308)

rotation is taken as one fourth its maximum theoretical value, the orbital changes for Comet Encke since 1865 can be produced by a loss of less than 1/500 of its mass each time it goes near the sun. Nevertheless, Comet Encke might still persist for more than 1,500 revolutions with an extremely slow diminution in brightness.

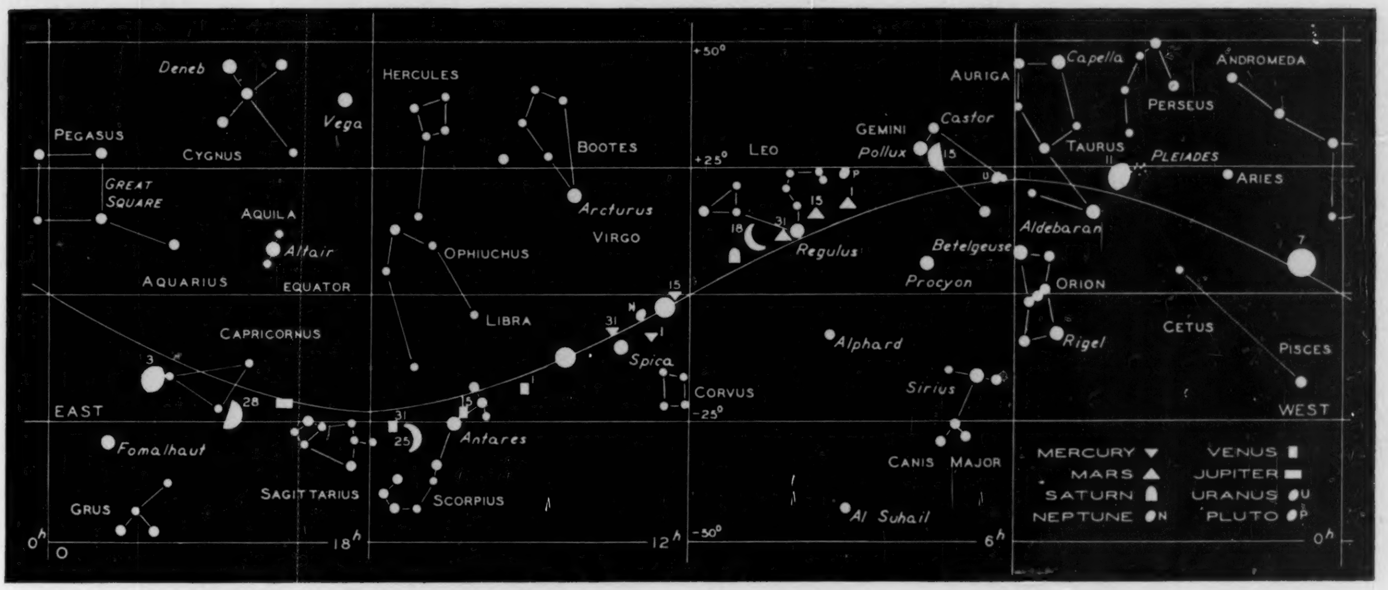
Such orbital effects occur in the opposite sense for Comet D'Arrest, and the corresponding mass loss is the same as for Comet Encke. For Comet Wolf I, the change in eccentricity corresponding to the observed deceleration in mean motion is too small to be observed.

The observed changes in mean motion of a comet lead to a determination of the maximum radius of meteoric spheres ejected by the gas escaping from the cometary nucleus, and to an upper limit to the possible radius of the nucleus. For Comet Encke in recent times, spheres of radius about 30 centimeters (density 4) might be ejected at perihelion; hence fireballs of the Taurid meteor swarm (associated with Comet Encke) could arise in this fashion. The maximum radius of the comet is calculated to be six kilometers, while the more likely radius of one half a kilometer corresponds to a 10-per-cent transfer of solar heat to the icy core.

The loss of meteoric material from the comet nucleus would be continuous, with a maximum rate at perihelion. Velocities of ejection would not exceed one kilometer per second for Comet Encke, although any icy particles ejected might attain higher velocities away from the sun by rocket effects. The spectacular activity of certain comets when nearest the sun may be produced by the collapse of "caves" produced beneath the meteoric matrix, permitting the heated material and possibly direct sunlight to act on ices with high vapor pressures at low temperatures. Photodissociation of the postulated gases can (*a priori,* at least) produce the observed nonmetallic spectra of comets.

The ices are made of the chemically active elements most common in the universe at large, but the model comet must originate at great distances from the sun and the earth. Some comets are known to have orbits that must take a million years to traverse once. Dr. Whipple's theory is consistent with the suggestion that the comets of short period, such as those in Jupiter's comet family with periods of about six or seven years, have all been captured by the gravitational pulls of the giant planets, Jupiter, Saturn, Uranus, and Neptune. On the new theory, in order to get the low temperature necessary to freeze the gases involved and to permit the coalescence of the ices and meteoric grains into one nucleus, a comet must have originated in what is practically interstellar space, but nevertheless still under the gravitational influence of the sun.

It has been proposed recently by the English astronomer, R. A. Lyttleton, of Cambridge University, that comets may originate when the sun passes through one of the numerous dust clouds that form part of the Milky Way galaxy (*Sky and Telescope,* June, 1949, page 196). The sun's gravity would draw together enough dust and gas to form a comet nucleus, somewhere at a distance between 20 and 1,000 astronomical units. Dr. Whipple's theory would favor the larger of these limits, or still greater distances.



THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Sun. A partial eclipse will occur on October 21st, observable from the Antarctic and Australia. Maximum obscuration will be 96 per cent.

Moon. The second total eclipse of the moon this year occurs on October 6-7

Mercury enters the morning sky on October 3rd, passing the sun in inferior conjunction. The planet attains western elongation on the 19th, rising 1½ hours before the sun. It is about 15° above the horizon at sunrise. On the morning of the 20th the crescent moon will be 1° 24′ south of Mercury, conjunction occurring at 15:48 UT.

Venus continues to gain in brilliance. On the 15th, of magnitude −3.7, it sets about two hours after the sun. The telescope disk is 18″ in diameter, 65 per cent illuminated. As the disk increases in apparent size, the illuminated fraction decreases.

Mars rises approximately an hour after midnight, not very conspicuous as its magnitude is +1.6. It passes a little over 1° north of Regulus on October 24-25. Compare its ruddiness with Regulus' white color.

Jupiter, found on the meridian at sunset, is at eastern quadrature with the sun on the 17th. Its diameter is 40″, viewed easily in a small telescope.

Saturn, in the morning sky, will become of more interest in the winter. It is in eastern Leo, of magnitude +1.2, thus somewhat brighter than Mars.

Uranus is about 1° northeast of Mu Geminorum. Its retrograde motion begins October 11th; therefore, little apparent motion is discernible all month. On the 15th, it is at $6^h\ 21^m.9$, +23° 36′.0.

Neptune is in conjunction with the sun on October 8th, hence not visible.

E. O.

OCCULTATION PREDICTIONS

October 9-10 **Zeta Arietis** 5.0, 3:12.0 +20-51.4, 18, Im: **A** 7:31.3 −1.4 +2.3 34; **C** 7:16.3 −1.6 +2.2 40; **E** 7:05.6 −0.2 +3.9 9; **F** 6:31.8 −0.4 +3.1 21. Em: **A** 8:46.5 −1.9 −1.3 275; **B** 8:39.5 −2.0 −2.1 288; **C** 8:40.1 −2.2 −0.5 264; **D** 8:29.9 −2.4 −1.7 286; **E** 8:03.3 −3.1 −1.2 288; **F** 7:44.8 −2.9 +0.4 269.

October 12-13 **136 Tauri** 4.5, 5:50.1 +27-36.1, 21, Im: **G** 6:13.7 −0.9 +0.3 138; **I** 6:07.8 −0.3 +0.8 125. Em: **G** 6:45.0 +0.8 +3.2 201; **I** 6:47.6 +0.6 +2.4 214.

October 27-28 **b Sagittarii** 4.6, 19:53.8 −27-18.4, 6, Im: **E** 22:50.2 −2.9 −1.5 140. Em: **E** 23:24.8 −0.7 +2.6 188.

For standard stations in the United States and Canada, for stars of magnitude 5.0 or brighter, all data from the **American Ephemeris** and the **British Nautical Almanac** are given here, as follows: evening-morning date, star name, magnitude, right ascension in hours and minutes, declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, **a** and **b** quantities in minutes, position angle on the moon's limb; the same data for each standard station westward.

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computations of fairly accurate times for one's local station (long. **Lo**, lat. **L**) within 200 or 300 miles of a standard station (long. **LoS**, lat. **LS**). Multiply **a** by the difference in longitude (**Lo — LoS**), and multiply **b** by the difference in latitude (**L — LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

A	+72°.5, +42°.5	**E**	+91°.0, +40°.0
B	+73°.6, +45°.6	**F**	+98°.0, +30°.0
C	+77°.1, +38°.9	**G**	+114°.0, +50°.9
D	+79°.4, +43°.7	**H**	+120°.0, +36°.0
I	+123°.1, +49°.5		

OCCULTATION OBSERVATIONS

Members of the Montreal Centre of the Royal Astronomical Society of Canada are undertaking more serious observations of lunar occultations. Their **Monthly Newsletter** points out that actually very few occultations can be observed from any one location, and of those that occur at a reasonably convenient time, some are likely to be rained out.

On June 9th, W. H. Birtles, using the centre's 6-inch refractor, successfully timed both the immersion and emersion of Antares. Following a suggestion from Dr. Alice Farnsworth, of Mt. Holyoke College, it was decided to establish a personal equation for several observers. Three instruments were used on the occultation of 1 Leonis on June 30th. Mr. Birtles manned the 6-inch refractor, Miss I. Williamson the centre's 12-inch reflector, and C. M. Good a 4-inch refractor.

A clothesline pole cut off Mr. Birtles' view just at the moment of occultation! Mr. Good timed the immersion at 22:03:38 exactly, whereas Miss Williamson timed it 0.8 second later.

ORIONID METEORS

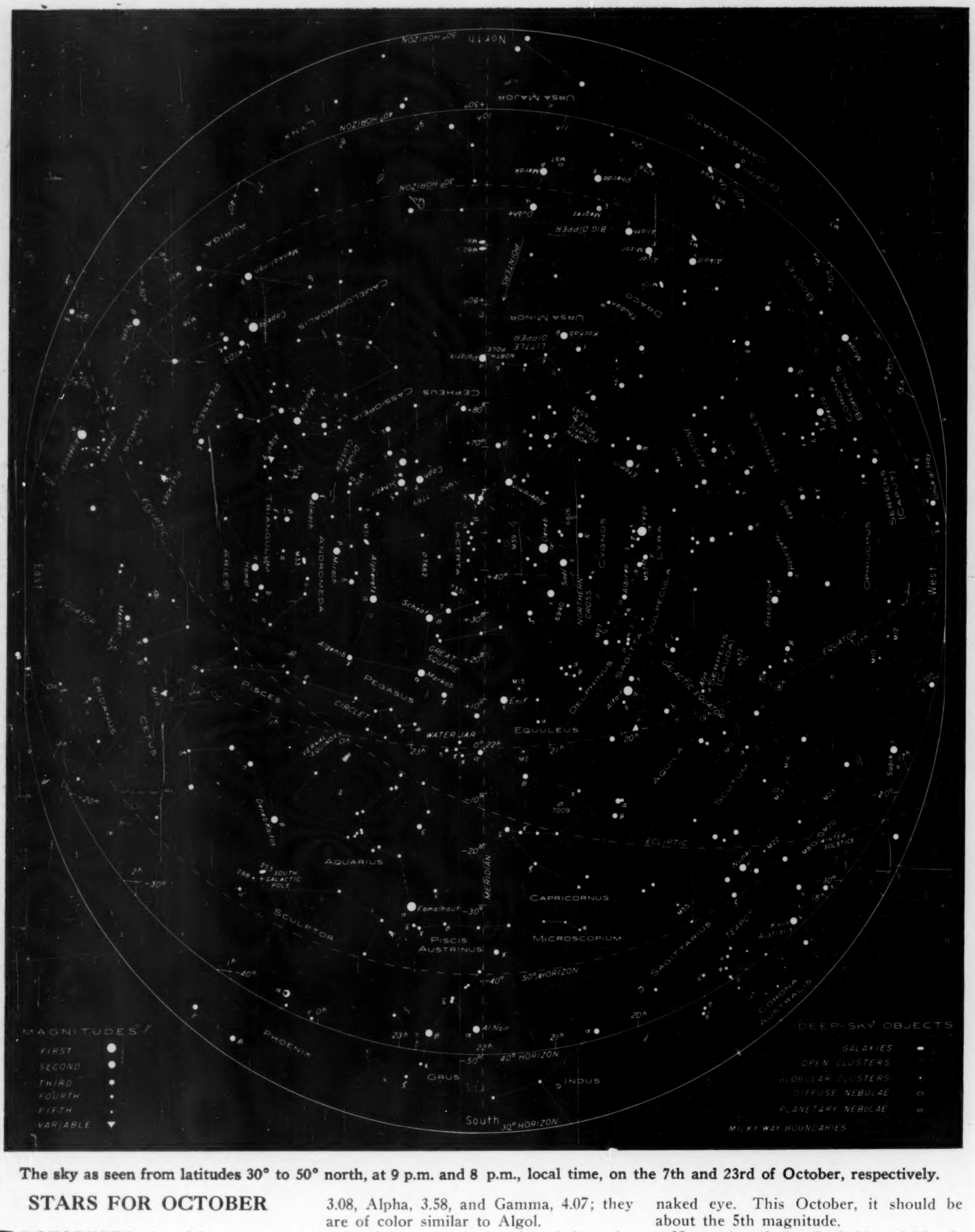
Favorable conditions will prevail this month for one of the reliable annual meteor showers. The Orionids will be at maximum October 19-20, and visible to a lesser extent four or five days preceding and following maximum. These meteors radiate from multiple centers ($6^h\ 24^m$, +15°) about 10° northeast of Betelgeuse, and are generally swift. Late in the month some meteors of the Taurid swarm may be observed, although maximum for that shower is not expected until a week after November begins.

E. O.

VARIABLE STAR MAXIMA

October 3, U Herculis, 7.6, 162119; 7, R Normae, 7.2, 1528**49**; 13, R Trianguli, 6.3, 023133; 17, W Andromedae, 7.5, 021143a; 17, RT Sagittarii, 7.9, 2011**39**; 18, T Hydrae, 7.7, 085**008**; 22, T Centauri, 6.1, 1336**33**; 24, R Leo Minoris, 7.2, 093934; 25, U Ceti, 7.5, 022813; 25, S Canis Minoris, 7.5, 072708. November 5, SS Virginis, 6.9, 122001; 7, R Ursae Majoris, 7.6, 103769; 8, T Normae, 7.4, 1536**54**; 9, V Bootis, 7.9, 142539a.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO. Only stars are included whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).



The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of October, respectively.

STARS FOR OCTOBER

PROTOTYPES of variable stars may easily be found in the fall sky. In Perseus, Algol winks once in a cycle of nearly three days, changing from magnitude 2.2 to 3.5 and back again. At minimum it is about one third as bright as at maximum. Compare it with nearby Triangulum, where the principal stars differ by very nearly half a magnitude: Beta, 3.08, Alpha, 3.58, and Gamma, 4.07; they are of color similar to Algol.

In the southern sky, just below the celestial equator, is Mira, Omicron in the constellation of Cetus. It fluctuates between magnitude about 3 or 4 and 9 in a period of some 330 days. Sometimes, as at its recent maximum late in August, it is as bright as 2.5, and then it outshines all the stars in its vicinity. Near minimum, of course, it simply "isn't there" to the naked eye. This October, it should be about the 5th magnitude.

Namesake of the Cepheid variables is Delta Cephei, in a constellation not far from the zenith on October evenings. Typical of the Cepheid variables, it pulsates in remarkably regular fashion between 3.6 and 4.2 in about 5 1/3 days. At its brightest, it resembles Zeta Cephei (3.6), and at its faintest it is about the equal of Epsilon Cephei (4.2).

The sky as seen from latitudes 20° to 40° south, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of January, respectively.

SOUTHERN STARS

IN THE ZENITH for southern observers of December and January skies at our chart times is the River, Eridanus, winding westward from Orion, thence south and west to Achernar. The name of this 1st-magnitude star is derived from the Arabic, meaning "the end of the river." It only is brighter than the 3rd magnitude among 293 naked-eye stars in Eridanus.

To the west is another constellation of great size, Cetus, the Whale, usually depicted as a sea monster resting with its "forepaws" in the River. Its brightest star is Deneb Kaitos, of magnitude 2.24, designated Beta Ceti and in the Whale's tail. It is brighter than Alpha Ceti, Menkar, of magnitude 2.82. All the other stars are fainter than these, except that Mira, the famous long-period variable, may occasionally exceed them.

Cetus is the last constellation to disappear from the southern sky of the group that is associated with the legend of Andromeda, in which Perseus, Pegasus, Cassiopeia, and Cepheus all have a part. Last glimpses of some of these may be had in the north and west. They are followed by Aries and Triangulum.

The latter constellation has little to compare with its southern counterpart, Triangulum Australe, whose three principal stars are skirting the southern horizon, circumpolar for observers living at least 27° south of the equator.